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SOME FEATURES OF THE PHILIPPINE ORNIS

WITH NOTES ON THE VEGETATION IN RELATION TO THE AVIFAUNA

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THIRTY-FIVE PLATES

SCARCITY OF SEA BIRDS IN PHILIPPINE WATERS

Ships from China approach Manila from the north and pass along the western coast of northern Luzon. A few steamers, mostly United States Army transports from California, pass through San Bernardino Strait, between Luzon and Samar, and thus reach the entrance to Manila Bay from the south. By either route Luzon is within sight for two or three days; but no gulls meet the ship to convoy her to port, and other sea birds are very scarce. A few stolid gannets, an occasional man-of-war bird, and an infrequent shearwater or petrel are all that can be expected.

Tubinares appear to be very rare in Philippine waters, for only three species have been recorded here. These are *Puffinus leucomelas* Temminck, one specimen of which was collected by Hugh Cuming,[1] and another, by Paul Bartsch;[2] *Puffinus chlororhynchus* Gould, collected by Dean C. Worcester off the Zambales coast in 1910;[3] and *Oceanodroma* species, collected by me near

[1] Salvin, Osbert, Catalogue of the Birds in the British Museum. London 25 (1896) 371. Mathews and Iredale, Ibis X 3 (1915), 592, fig. 9, *b* and *d*, make *Puffinus leucomelas* the type of a new genus, *Calonectris*. They also record two "adult breeding birds in good plumage" from Pescadores Islands, May, 1909.

[2] Mearns, E. A., Proc. U. S. Nat. Mus. 36 (1909) 464.

[3] McGregor, R. C., Philip. Journ. Sci. § D 6 (1911) 183.

Mariveles during a severe typhoon.[4] The last specimen lacks the tail, and the species has not been determined. It is possible that both petrels and shearwaters nest on some of the many, small, uninhabited islands of the Archipelago. The gannets and the man-of-war birds have been rarely collected in Philippine waters, yet they are abundant on their breeding grounds, the small islands of Sulu Sea.[5] Gannets are believed to nest also on Didicas Rocks, north of Luzon.[6] During typhoon weather man-of-war birds are seen near Manila, and there is a record of *Fregata ariel* (Gould) having been collected on the northern coast of Luzon.[7]

Larus ridibundus Linnæus, a small species of gull, is fairly common in Manila Bay, but the genus is poorly represented in Philippine waters. The only other gull recorded is *Larus vegæ* (Palmen). However, there are several species of terns. *Hydrochelidon leucoptera* (Temminck) is rare, and *H. hybrida* (Pallas) is fairly abundant. *Anous stolidus* (Linnæus) has been collected in Sulu Sea, and *Micranous worcesteri* McGregor, an endemic species, breeds in abundance on Cavilli Island, in Sulu Sea.[8] Seven species of *Sterna* have been recorded from various parts of the Islands. *Sterna boreotis* Bangs is a large and abundant species; the others are small and of irregular distribution and occurrence, and very little is known about them. With the exception of *Micranous worcesteri,* all of these terns are of rather wide distribution in the world. Not much effort has been made to collect them, and the Philippine records are very sporadic. For example, *Sterna sinensis* (Gmelin), which ranges from the Chinese and Indian seas to Australia, has been recorded in the Philippine Islands only from widely separated islands—Mindanao, Mindoro, Palawan, and Polillo. Siquijor was for a long time the only Philippine locality for *Sterna fuscata* Linnæus, but this species is now known to breed on Maeander Reef.[9] Panay is the type locality of *Sterna anætheta* Scopoli; although this species is well known in many parts of the world, the records of it as a Philippine bird are surprisingly few. *Sterna gracilis*

[4] Idem, Bull. Philip. Mus. 4 (1904) 12.

[5] Worcester, D. C., Philip. Journ. Sci. § D 6 (1911) 167.

[6] Ibid. § A 2 (1907) 275.

[7] Grant, W. R. O., Ibis VII 2 (1896) 128.

[8] McGregor, R. C., Philip. Journ. Sci. § D 6 (1911) 184. Mathews places this species in the genus *Megalopterus;* see also Ridgway, Birds of North and Middle America 8 (1919) 553.

[9] McGregor, R. C., Philip. Journ. Sci. § D 13 (1918) 4.

Gould [10] has been only recently credited to the Philippines. The cormorants, the pelicans, and the grebes are represented by a single species each—even these are seldom found about salt water.

The foregoing include all of the Philippine sea birds. Puffins, guillemots, sea ducks, and auklets, characteristic of northern seas, are altogether lacking here. By describing this feature of the Philippine ornis first there is danger of giving it too much emphasis, but this scarcity of sea birds is sure to impress anyone that is familiar with the many sea birds of Asia or of the Pacific coast of North America.

TOPOGRAPHIC FEATURES OF THE MANILA AREA

Guarding the entrance to Manila Bay are several rocky islands—Monja, Corregidor, Caballo, Fraile—the largest and highest of which is Corregidor. To the northwest of the entrance are the forested Mariveles Mountains, of Bataan Province, with elevations of 1,200 to 1,400 meters; [11] to the southeast are the lower areas of Cavite and Batangas Provinces.

Manila lies northeast of Corregidor Island, nearly opposite the entrance to Manila Bay, at the mouth of Pasig River. From the water the city usually appears to be enveloped in a smoky haze, and the monotony of the low land immediately surrounding the town is broken only by the dim outlines of the distant mountains of Laguna, Rizal, and Pampanga Provinces. At one time most of the land on which Manila is situated must have supported nipa and mangroves and have been cut by numerous sluggish streams. The swamps have been gradually filled, so that scattered unfilled areas and the numerous tortuous esteros, or tidal creeks, are the only visible remains of the old swamps. The esteros are tributary to Pasig River, which is the outlet of Lake Bay and flows through Manila.

North and northwest of Manila the area near the bay shore in Bulacan and Pampanga Provinces is a vast swamp cut by esteros, an area similar to what Manila must have been before there was a city. Many of these streams are outlets for the Pampanga and other rivers, which drain an immense area of low, flat land north and northwest of Manila. The shallow water of Manila Bay off shore from this swampy area covers a deposit of deep black mud. As the shore enters Bataan

[10] Ibid. 3.

[11] See Whitford, H. N., Philip. Journ. Sci. 1 (1906) 376 and map.

Province, it turns sharply to the south, the land becomes more elevated, with alternate stretches of sand beach and rocky shore and the water near the land is deeper. South of Manila the coast extends in a gentle curve to Cavite and Cañacao. In this direction a fine sand beach extends from Pasay to Parañaque. Inland, a few kilometers southeast of Manila, the land has a gentle slope to the slightly elevated area that overlooks Lake Bay. The military reservation of Fort William McKinley is situated on this high ground.

CONSPICUOUS BIRDS OF MANILA

As the ship slowly enters the fine artificial basin that is Manila harbor, it is usually attended by a dozen or more scavenger hawks—*Haliastur intermedius* Gurney. The adult is a handsome bird, having the head and lower parts white and the rest of the plumage rich chestnut, but immature individuals are very commonplace in appearance. This species is especially abundant about shipping, both in bays and rivers, and feeds on scraps from ships' galleys and on other garbage. Occasionally individuals or small flocks of *Sterna boreotis, Hydrochelidon hybrida,* and *Larus ridibundus* may be seen in the harbor, but they are seldom abundant.

The first land bird to greet the visitor to Manila will doubtless be a fringillid, *Passer montanus* (Linnæus). This species is a native of Europe that is now well established in Manila and in many of the towns along the railroads or that are reached by water transportation. It is found in Dagupan, north of Manila, on the railroad and probably farther north and has reached many of the towns on Lake Bay. Outside of Luzon the mountain sparrow has extended its range to Cebu. This sparrow may be seen in small flocks along wagon roads and railroads and in old fields at some distance from houses. At first sight the mountain sparrow is easily mistaken for the European house sparrow, *Passer domesticus* (Linnæus), but the two species are sufficiently distinct. The former does not seem to increase with the rapidity of its less favorably known cousin and is not so great a pest.

STARLINGS AND LOCUSTS

The next bird that will be noted even by those who are not devoted to ornithology is a slate-gray starling, *Æthiopsar cristatellus* (Linnæus), about the size of an American robin. When this bird flies, a white band across the primary quills is conspicuously displayed. The feathers of the frons are long and erect

or strongly antrorse, giving the head a curious profile view. The larger tail feathers are tipped with white. For several years there was a roost of these starlings in the trees in front of the Luneta police station, on Bagumbayan Drive, where their chatter was very noticeable at dusk. A closely related species, *Acridotheres tristis* (Linnæus), was introduced into Hawaii, where it is well established; I found it extremely abundant on Maui Island in 1900.[12] Both of these species are natives of southern Asia.

Æthiopsar cristatellus appears to have been introduced by the Spanish Government about 1850 with the hope that it would reduce the number of locusts, which were and still are a very serious pest to the agriculturist.

A quotation in Blair and Robertson [13] indicates that at least three attempts, 1849 to 1852, were made to introduce and establish a species of *martín* (probably one of the starlings) in the Philippines. Foreman [14] says:

> In 1851 the Government imported some MARTINS from China with the hope of exterminating the locusts. When the birds arrived in the port of Manila they were right royally received by a body of troops. A band of music accompanied them with great ceremony to Santa Mesa, where they were set at liberty, and the public were forbidden to destroy them under severe penalties.

Martín, as a Spanish word, is correctly applied to birds called starlings in English and is not equivalent to "martin" (species of Hirundinidæ). I have been under the impression that the bird introduced into the Philippines received its local name from Juan Antonio Martinez, governor from 1822 to 1825, but this governor left the Philippines twenty-five years before the arrival of *pájaros martines.* Casto de Elera[15] gives the name *martín langostero* for *Acridotheres cristatellus.* In Manila the common name for this species seems to be martines, not martinez as recorded by me.[16] As the Tagalog language makes no distinction in form to indicate number in nouns, the Spanish *pájaros martines* would readily become "martines," singular and plural.

Probably this starling does eat some locusts, but it has not

[12] Condor 4 (1902) 60.

[13] The Philippine Islands 1493–1898. The Arthur H. Clark Company, Cleveland 51 (1907) 127.

[14] The Philippine Islands ed. 3. Charles Scribner's Sons, New York (1906) 341.

[15] Fauna de Filipinas. Imprenta del Colegio de Santo Tomás, Manila 1 (1895) 199.

[16] A Manual of Philippine Birds. Bureau of Science, Manila (1909) 717.

increased in numbers rapidly enough to be of marked value in combating the locust pest. Like the mountain sparrow the starling has spread to towns in the vicinity of Manila; it is found in some of the towns about Lake Bay, and it was noted at Tagudin, Ilocos Sur, in 1909;[17] but while the former species is also established in the city of Cebu, the latter has been recorded only on Luzon.

The damage done by locusts constitutes one of the most serious problems of the agriculturist in the Philippine Islands.[18] The presence of these insects may be unsuspected until a few appear and alight. These may be so few, perhaps from three to five individuals to a square meter, as to cause little damage and comment. They may remain to feed, but often they move on in a few hours. Then there may appear a thicker flock so that ten, fifteen, or twenty are flushed at each step. As they become more numerous the rushing of their wings has an ominous sound, they obscure the sun, and bright green trees turn brown as the myriads settle to feed; corn, rice, and coconut leaves are stripped to the midrib. They settle on bamboos in such numbers that their weight causes even the largest of these trees to bend so that the tips of the stems nearly touch the ground. After the locusts have left, the ground beneath a clump of bamboo is littered with excreta and shredded leaves, as if twenty pounds of dust shot had been fired into the tops of the trees from the horn of a phonograph. They will eat even the dry nipa leaves on the roofs of houses. In a few hours or a day the main flock moves on, and at the end of two days there is usually none left.

The attempt to reduce the number of locusts by killing the adults is much like trying to restrain the tide with a broom. When the flock of locusts attacks a crop, there is comparatively little value in anything that can be done against them. Millions are caught in large scoop nets; these are killed in boiling water, and hundreds of bushels are sold for food in the Manila markets. Several species of birds eat locusts, and at times a curious mixed company of rollers, hawks, cuckoos, and other species can be seen in the air and on the ground eating them to repletion. Although birds eat many of the adult locusts, ten times as many birds would have no perceptible effect upon the flocks. Birds probably eat many locusts in the young stages and may thus

[17] Philip. Journ. Sci. § D 5 (1910) 219.

[18] See Jones, C. R., and Mackie, D. B., Philip. Agr. Rev. 6 (1913) 5–22; also Mackie, D. B., ibid. 538.

prevent more frequent flights that might destroy everything green.[19]

When the locusts have been cooked, they are dried, packed in sacks or baskets, and saved for food. The wings, the legs, and the dorsal shield of the thorax are removed; and the heads and bodies are fried. I have eaten locusts but cannot say that I care for them. They seem to have little flavor except that of the added salt, pepper, and vinegar, while the chitinous substance in the body covering is disagreeable. It is much the same as eating shrimps without removing the shells. The females are said to be of especially fine flavor when the bodies are distended with eggs. Boiled and partly dried locusts are sold in the Manila markets whenever they can be caught nearby.

Experiments in the destruction of this pest with bacterial disease of locusts have been made, but the results were not very satisfactory.[20] Recently the use of poisonous gas after European war methods has been suggested, but the technic does not seem to have been perfected; and I have not learned whether

[19] Some idea of the numbers of the locusts can be gained from the following from Jones and Mackie, op. cit.:

Using large circular hand nets in Cebu "in one hour three men using these nets captured 12 cavans [1 cavan, or caban, equals 75 liters] of insects; also at Mandaue, Cebu, sixteen nets caught 57 cavans of voladores [fliers, that is, winged locusts] in five hours." [p. 14.]

"At Carcar, Cebu, eleven persons engaged in digging out egg clusters averaged about 125 liters (about six kerosene cans full) of egg clusters per day." [p. 12.]

"It is estimated that the pit method accomplished the destruction between June and October of upwards of 8,000 cavans of hoppers in Bohol, while within a very short space of time some 20,000 cavans were reported to have been destroyed in Iloilo, and the total amount for the Province of Cebu may be estimated anywhere between 10,000 and 25,000 cavans." [p. 14.]

"Wild birds, however, are of more importance than is generally believed for they, from the very first appearance of the young locusts as they issue from the ground, wage a continuous warfare upon the swarm."

These authors (p. 19) consider the following to be "the most important locust destroyers" among Philippine birds:

Otomela lucionensis (Linnæus).
Bubulcus coromandus (Boddaert).
Halcyon gularis (Kuhl).
Halcyon chloris (Boddaert).
Alcedo bengalensis Gmelin.
Numenius variegatus (Scopoli).
Numenius arquatus (Linnæus).
Numenius cyanopus Vieillot.
Charadrius fulvus Gmelin.
Excalfactoria lineata (Scopoli).
Turnix fasciata (Temminck).
Gallus gallus (Linnæus).
Eurystomus orientalis (Linnæus).
Merops americanus P. L. S. Müller.
Merops philippinus Linnæus.

[20] See Barber, M. A., and Jones, C. R., Philip. Journ. Sci. § B 10 (1915) 163–176.

this was proposed seriously or merely in fun. It is probable that the cost would be out of all proportion to the benefits.

OTHER LAND BIRDS FOUND IN MANILA

The mountain sparrow and the martin langostero are the only species of birds that have adapted themselves to life in the busy parts of the town and that can be found there in abundance; even if we extend our observations to include the entire city, surprisingly few other birds can be seen. Nearly all of the birds to be found in or near Manila are migratory species or range throughout the Archipelago. As I shall point out in more detail, most of the endemic species of birds live only in the virgin forest and disappear with it. A very few of these species have become adapted to life in the cultivated areas and in the second-growth forests.

Many of the streets of Manila are shaded by large trees, the most abundant being several kinds of palms and various species of Leguminosæ with beautiful and conspicuous blossoms. Among the latter are the royal poinciana, *Delonix regia* (Bojer) Rafinesque, with gorgeous red and yellow flowers; the rain tree, *Samanea saman* (Jacquemont) Merrill, with rather small pink flowers; *Cassia siamea* Lamarck and *Peltophorum inerme* Naves, both with large showy yellow flowers; and the dap-dap, *Erythrina indica* Lamarck, with large red flowers.[21] The old botanic garden contains examples of many species of shrubs and trees, and there are private and commercial gardens that contain interesting collections of plants. The Cementerio del Norte, the largest burying ground of the city, is a beautiful example of what can be done in gardening on a large scale.[22] Very few of these cultivated plants are native species, and very few native birds take advantage of the planted vegetation.

A common bulbul, *Pycnonotus goiavier* (Scopoli); a migratory shrike, *Otomela lucionensis* (Linnæus); and a small, inconspicuous warbler, *Acanthopneuste borealis* (Blasius), occasionally visit the trees in my yard; and these three species are fairly common in Manila. The rufous-bellied cuckoo, *Cacomantis merulinus* (Scopoli), is often seen and heard in Manila, where its curious querulous call has earned for the bird the Tagalog name *masakit*. A shy thrush, the Siberian rubythroat, *Calliope calliope* (Pallas), occasionally sings early in the morning and at dusk. Three species of kingfishers—*Halcyon gularis, H. chloris,*

[21] See Merrill, E. D., Qr. Bull. Philip. Bur. Public Works 2[1] (1913) 34–41.

[22] See Merrill, E. D., Catalogue of the Plants Cultivated in the City Nursery at Cementerio del Norte. Manila, Bureau of Printing (1910) 40 pp. [Published by the city of Manila.]

and *Alcedo bengalensis*—are fairly common about Manila. The second and the third fish in small tidal streams within the city and often rest in convenient clumps of bamboo. I have found *Alcedo bengalensis* fishing in a small ditch, near the Walled City; and a specimen of *Halcyon chloris* can often be seen on Bagumbayan Drive, near the botanic garden. A grass warbler, *Cisticola exilis* (Vigors and Horsfield), sits on a telegraph wire, and a tailorbird, *Orthotomus chloronotus* Grant, sings in a bamboo thicket a few squares from the Bureau of Science. A small hawk, *Falco severus* Horsfield, has long made its headquarters on the roof of the Bureau of Science building. Two small swifts, *Tachornis pallidior* McGregor and a species of *Collocalia,* frequently fly over various parts of the city. Swallows, *Hirundo javanica* Sparrman and *H. gutturalis* Scopoli, can be seen over Pasig River in the busiest part of the city; and a large flock of these swallows regularly gathers the adults of the tobacco beetle, *Lasioderma serricorne* Fabricius,[23] as they emerge from a tobacco warehouse. Two species of doves, *Streptopelia dussumieri* (Temminck) and *Œnopopelia humilis* (Temminck), can be found in some of the few clumps of bamboo that remain about the edges of town.

Many of the birds mentioned in the last paragraph are not dependent upon any particular type of vegetation and are found feeding about streams, grasslands, second-growth thickets, and forests. The tailorbirds do not adapt themselves to planted vegetation in cities, but vanish with the clumps of bamboo and other wild thickets. The three kingfishers mentioned take kindly to man's alteration of the vegetation, and all of them are among the commonest species of birds to be noted on nearly every island. *Alcedo bengalensis* often feeds along the beach at low tide, and the two larger species are frequenters of coconut groves. I have recorded the interesting case of *Halcyon chloris* killing a half-grown chicken.[24] It sometimes happens that examples of these three kingfishers are within sight at one time, and they are conspicuous elements of the ornis.

Halcyon chloris is the noisest of these and its harsh, somewhat metallic call, "kak kak kak, kak kak," can be heard in the early morning, at midday, and late at night.

SHORE BIRDS OF MANILA

No city as large as Manila will offer many inducements to shore birds, but there are some low unfilled spots and natural

[23] For the life history of this beetle see Jones, C. R., Philip. Journ. Sci. § D 8 (1913) 1.

[24] Philip. Journ. Sci. § A 2 (1907) 346.

tidal creeks that are not altogether deserted. The common sandpiper, *Actitis hypoleucos* (Linnæus), clings to his old hunting grounds along the shores of an estero in Malate, and I can often see his teetering body from my window. Curlews, *Numenius variegatus* (Scopoli), stop each year on some marshy tideland that is now surrounded by houses. A few years ago we netted rails in a marshy area that is now filled and forms a part of Taft Avenue and a part of the Bureau of Science lawn. One day my cat brought into the house a specimen of the banded crake, *Hypotænidia torquata* (Linnæus). Small plovers can still be found within the city limits on Pasay Beach.

SHORE BIRDS OF THE PAMPANGA DELTA

The area now occupied by Manila was formerly inhabited by swamp-loving species and was visited by migratory shore birds. Nearly all of these have been driven out by the filling of their marshy haunts, and no other species have taken their places. However, within a few kilometers of Manila can be found two groups of birds, the members of which are characteristic of the open lowland of nearly all the islands. One of these groups includes the shore birds and the waders, the other comprises the birds of grasslands and second-growth thickets.

At the head of Manila Bay on the beach and about the openings of the delta of Pampanga River, already mentioned, there are wide flats, and beyond the flats is much shallow water. This is a way station of vast flocks of plovers, sandpipers, snipe, curlews, and godwits. I have never seen anywhere else such clouds of shore birds. I have published records of some of the rarer species,[25] and doubtless others will be added from time to time. The following is a nearly complete list of the shore birds that have been collected in the vicinity of Obando, Bulacan Province, Luzon, a few kilometers from Manila:

Arenaria interpres (Linnæus).
Ochthodromus geoffroyi (Wagler).
Ægialitis dubia (Scopoli).
Numenius arquatus (Linnæus).
Numenius cyanopus Vieillot.
Numenius variegatus (Scopoli).
Limosa baueri Naumann.
Limosa limosa (Linnæus).
Macrorhamphus semipalmatus (Jerdon).
Totanus eurhinus Oberholser.
Totanus stagnatilis Bechstein.
Actitis hypoleucos (Linnæus).
Terekia cinerea (Güldenstädt).
Glottis nebularius (Gunnerus).
Rhyacophilus glareola (Linnæus).
Pisobia ruficollis (Pallas).
Pisobia subminuta (Middendorff).
Heteropygia acuminata (Horsfield).
Erolia ferruginea (Brunnich).
Canutus rogersi Mathews.
Canutus tenuirostris (Horsfield).
Limicola platyrhyncha (Temminck).

[25] Philip. Journ. Sci. § D 11 (1916) 269–277, 2 text figs.; 13 1–19, 3 pls., 10 text figs.

Besides the preceding species, which are found principally along the mud flats, several species of herons, rails, ducks, etc., inhabit the tidal streams and the marshland.

Snipe are abundant in rice fields during the fall and afford excellent sport. The most abundant species is *Gallinago megala* Swinhoe, while about one in fifty will be either of the closely related species *G. gallinago* (Linnæus) and *G. stenura* (Bonaparte). The curious painted snipe, *Rostratula capensis* (Linnæus), appears to be a resident species; it is slow and heavy in flight and somewhat rare.

Nearly all of these species of water birds have been recorded from one or more of the other large islands, and they may be expected to occur on any island whenever and wherever the time and the conditions are favorable. They are birds of passage, some of them of cosmopolitan range, others with a wide range in the Eastern Hemisphere. They are interesting but are not characteristic elements of the fauna and so indicate nothing as to the relation of this ornis to others.

BIRDS OF THICKETS AND GRASSLANDS

The open grasslands that have replaced the original forest support plant species for the most part of wide distribution. These areas are inhabited by birds of comparatively wide distribution, at least in the Philippine Islands.

In grassland such as exists in the area southeast of Manila and near Fort William McKinley one of the most characteristic birds is *Pratincola caprata* (Linnæus). This species calls to mind the American lark bunting, *Calamospiza melanocorys* Stejneger, in the black and white plumage of the male, in its haunts and habits, and in the fact that the sexes are very differently colored. Other species characteristic of grasslands are: *Cisticola exilis* (Vigors and Horsfield), a bird about the size of a bush tit and with a tail built on the same plan; *Alauda wattersi* Swinhoe, an oriental subspecies (?) of the skylark; *Anthus rufulus* Vieillot, somewhat similar to the North American *Anthus rubescens* (Tunstall); *Mirafra philippinensis* Ramsay, a thick-billed lark; *Megalurus palustris* Horsfield, a long-tailed, white, gray, and brown warbler the size of a chat; *Megalurus tweeddalei* McGregor, a smaller warbler; *Excalfactoria lineata* Scopoli, a small quaillike bird, the male of which has black and white markings on the head and the throat that are curiously suggestive of *Lophortyx californica* (Shaw); *Caprimulgus manillensis* Walden, a beautiful nightjar; *Tachornis pallidior* McGregor and species of *Collocalia,* small swifts that usually hunt over open land;

Munia jagori Martens, a weaver finch that often congregates in flocks of from two to three hundred individuals, although much smaller flocks are commoner. *Uroloncha everetti* (Tweeddale) is a less-abundant weaver finch.

One of the most interesting birds found in thickets and tall grass is *Centropus viridis* (Scopoli), a large, long-tailed cuckoo, entirely different from the small North American cuckoos and more like the roadrunner, *Geococcyx californianus* (Lesson). Its length is nearly 40 centimeters, of which 25 centimeters are appropriated for the wide wedge-shaped tail, the feathers of which are 3.5 centimeters wide. The entire plumage is lax and slightly harsh, thus being very suggestive of the roadrunner.

The grass owl, *Tyto longimembris* (Jerdon), which is very similar to the North American barn owl, is at home in open grassy country and is fairly abundant in the area under consideration. A species of Chinese quail has been introduced and seems to thrive in this area.

In bamboos and second-growth thickets that may grow in scattered clumps in the grassland, especially near streams, are found other species of wide distribution. Three species of doves, already mentioned, feed in fields and along roads and often rest in bamboos; a migratory green dove, *Chalcophaps indica* (Linnæus), feeds on the ground in thickets, flies near the ground, and avoids the open; *Copsychus mindanensis* Boddaert, a conspicuously marked, black and white, thrushlike bird with a pleasing hearty song, is found in bamboo thickets.

Another common black and white bird is *Rhipidura nigritorquis* Vigors; this creature appears to be very well pleased with itself for it seems to enjoy nothing better than to twist and turn, spread its long and strongly graduated, white-tipped tail, expand its wings, twitch its tail up and down, then flit to another twig and repeat the series. It has a harsh rasping call not at all consistent with its conceited actions, but it also executes a simple song of a few notes. This flycatcher is widely distributed in the Archipelago, having been noted on thirty-two islands, but it does not seem to occur north of Luzon; it is characteristic of lowland second-growth thickets and small forest and is quite at home in the mangroves.

Another equally common flycatcher, characteristic of the second-growth forest and of thickets bordering streams, is a beautiful blue species, *Hypothymis occipitalis* (Vigors); on the occiput there is a velvety black patch, and across the forebreast there is a narrow black crescent; the short feathers immediately posterior of the nostrils and in the rami of the lower jaw are

black; most of the head is smalt blue, slightly darker and with a faint violet cast on the throat and breast, fading gradually to white on abdomen, flanks, and under tail coverts; the wings and upper parts are darker to about azurite blue; even the bill, eyelids, legs, and feet are blue. This flycatcher sits very quietly on a twig and often is not noticed until it moves to another perch. Like *Rhipidura nigritorquis* this species is found in many parts of the Archipelago.

Some of the other land birds that are more or less abundant in the vicinity of Manila, as well as throughout the Islands, and that inhabit open grassland, thickets, or second growth are:

Osmotreron axillaris (Bonaparte).
Osmotreron vernans (Linnæus).
Circus spilonotus Kaup.
Circus melanoleucos (Pennant).
Butastur indicus (Gmelin).
Elanus hypoleucus Gould.
Ninox japonica (Temminck and Schlegel).
Tyto longimembris (Jerdon).
Eurystomus orientalis (Linnæus).
Merops americanus P. L. S. Müller.
Merops philippinus Linnæus.
Cacomantis merulinus (Scopoli).
Eudynamys mindanensis (Linnæus).
Lalage niger (Forster).
Pycnonotus goiavier (Scopoli).
Petrophila manillensis (J. R. Forster).
Artamus leucorynchus (Linnæus).
Motacilla melanope Pallas.
Budytes leucostriatus Homeyer.
Emberiza sulphurata Temminck and Schlegel.
Padda oryzivora (Linnæus).
Oriolus acrorhynchus Vigors.
Lamprocorax panayensis (Scopoli).
Sarcops calvus (Linnæus).

The species enumerated so far are nearly all that can be found within several kilometers of Manila; there are doubtless a few more, but no effort has been made to record all of the species. Most of them are of wide distribution, at least within the Philippines; and are to be found wherever the vegetation is similar to that about Manila.

THE INTRODUCED ELEMENT OF THE PHILIPPINE FLORA [26]

In order to understand the distribution of the plants and the animals in the Philippine Islands and to search for and to collect specimens of the endemic species, it is necessary to realize that the areas now under cultivation or overgrown with grass and thickets were originally covered with forest. The casual visitor to the Philippines, even though he makes a fairly extended tour of the Islands, gets no idea of the forest. He sees vast areas covered with grass; fields of cultivated rice, sugar cane, corn,

[26] Prof. E. D. Merrill and Dr. W. H. Brown have read my entire discussion of the Philippine flora and have made welcome corrections and suggestions; as a result I believe that this part of the paper is in reasonable agreement with our present knowledge of the Philippine vegetation.

and tobacco, interspersed with various trees and shrubs; long, irregular lines of bamboo; hedges of madre cacao; many groves of coconut trees; and hillside and valley planted to bananas and abacá. Often a view across country suggests a distant forest, but on closer inspection the supposed forest proves to be merely planted fruit trees, bamboos, etc., scattered among cultivated fields. If his curiosity leads the traveler to a personal investigation and closer view of the jungle near some of the smaller towns, he finds that he must keep to the beaten path. On each side of the trail the tangle of coarse grasses, tough vines, and stiff shrubs effectually bars progress. Even with the help of a bolo, cutting a new trail in the average jungle is slow work.

There are real forests within easy reach from Manila, but comparatively few persons know where to look for them. The casual visitor then leaves the Islands with no adequate idea of their endemic vegetation. What is true here is doubtless true of other tropical countries visited by travelers that are not botanists, and thus has arisen the more or less prevalent, popular conception that the tropical vegetation is typically a jungle.

Whitford [27] says:

> In the more thickly settled portions of the Islands, and along well-traveled trails, practically all the original forests have disappeared, giving place to grass or second-growth forests. The second-growth forests are seen by the average traveler, and have conveyed the wholly wrong impression that the forests of the Philippines, and, it is believed, of the Tropics in general, are a densely overgrown mass of impenetrable jungle.

Some visitors to the Islands have been interested in the many curious plants that can be seen even about Manila, while others are enthusiastic in their praises of Philippine fruits; yet a large percentage of the species of plants found in and about Manila have been introduced. Few species yielding edible fruit are natives of the Philippine Islands, and not one is found among the more commonly cultivated fruit trees.

Of the 1,007 species of plants recorded by Merrill [28] for the vicinity of Manila, only 124 are endemic; 550 are indigenous—that is, native to the Archipelago or introduced by natural agencies; while 457 have been purposely or inadvertently introduced by man. Of the introduced species more than half are now spontaneous and about 225 are rarely found except as cultivated plants.

If we exclude the abacá plant (*Musa textilis* Née) and the various trees yielding timbers, gums, and resins, a few palms, some bamboos, the rattans,

[27] Bull. Philip. Bur. Forestry 10 [1] (1911) 15.
[28] Philip. Journ. Sci. § C 7 (1912) 152.

etc., it will be found that practically all the species now found in the Archipelago that are of the greatest importance in the economy of the native, whether for food, for condiments, for clothing, for dyes, for ornamental purposes, and very many for medicinal purposes, have originated outside of the Philippines, and have purposely been introduced at one time or another. Not a single important food plant or fruit tree has originated in the Archipelago, but all have been introduced.[29]

In order to emphasize the statements in the preceding paragraph I have selected the names of one hundred well-known species from Merrill's Flora of Manila,[30] not one of which is a native of the Islands. All of these are useful in one way or another and have been purposely introduced.

GRAMINEÆ

Zea mays L.; corn, maize, mais. Introduced by the Spaniards at an early date; a native of tropical America; extensively cultivated for food.

Saccharum officinarum L.; sugar cane, caña dulce, tuba. Probably a native of tropical Asia; introduction into the Philippines prehistoric; a source of sugar.

Andropogon zizanioides Urb.; vetiver, moras or raiz de mora. A native of India, widely distributed in the Philippines and certainly introduced; its aromatic roots yield an essential oil.

Oryza sativa L.; rice, arroz, palay. A native of tropical Asia; introduction into the Philippines prehistoric; cultivated throughout the Philippines for the grain and the straw. There are many varieties cultivated in the Islands. This species is nowhere wild, but there are two or three wild species of the genus *Oryza* in the Philippines.

Bambusa vulgaris Schrad.; bamboo, cauayan quiling. Widely distributed in the Philippines; probably not a native, but of prehistoric introduction; used for general construction purposes.

Bambusa blumeana Schultes f.; "true bamboo," cauayan totoo. Common throughout the Islands; its introduction prehistoric, a native of Malay Peninsula and Archipelago; the bamboo most used for building material.

PALMÆ

Cocos nucifera L.; coconut, coco, niog. Cultivated throughout the Islands at suitable elevations. The original home of the coco palm is not definitely known, but it is certainly not a native of the Philippine Islands.[31] Its introduction was prehistoric. This palm is a source of food, drink, oil, thatch, and firewood.

Areca catechu L.; betel-nut palm, bunga. Cultivated, of prehistoric introduction; probably a native of India. The nut is chewed with lime and leaves of *Piper betle* as a stimulant.

[29] Ibid. 169.

[30] A Flora of Manila. Bureau of Science, Manila (1912).

[31] See Cook, O. F., Contr. U. S. Nat. Herb. 7 (1901) 298 and 14 (1910) 271, favoring the American origin of the coco. Beccari, O., Philip. Journ. Sci. § C 12 (1917) 27, opposes Cook's theories.

ARACEÆ

Acorus calamus L.; sweet flag, acoro, lubigan. Certainly introduced here; medicinal.

Colocasia esculentum Schott; taro, gabi. Probably a native of India, now cultivated in all tropical countries; cultivated for food throughout the Islands.

BROMELIACEÆ

Ananas comosus Merr.; pineapple, piña. A native of tropical America, introduced here by the Spaniards; cultivated for food and fiber.

Asparagus officinalis L.; asparagus, espárrago. A native of Europe, cultivated for ornamental purposes.

Allium cepa L.; onion, cebolla, sebuyas. A native of Europe; cultivated in Manila by Chinese market gardeners.

AMARYLLIDACEÆ

Agave cantala Roxb.; sisal hemp, century plant, maguey. A native of tropical America; cultivated in the Philippines as an ornamental and for its fiber.

Polianthes tuberosa L.; tuberose, azucena. A Mexican genus and species; cultivated for the fragrant flowers.

Crinum zeylanicum L.; lily, lirio. A native of tropical Asia and Africa; an ornamental.

DIOSCOREACEÆ

Dioscorea alata L.; yam, ubi. Found from India to Malaya; throughout the Islands, but certainly not indigenous; cultivated for its edible tubers.

MUSACEÆ

Musa paradisica L.; banana, platano, saguing. Cultivated throughout the Philippines, but its introduction probably prehistoric. The bananas yield fruit throughout the year, which can be found in most parts of the Islands. The leaves are used to a considerable extent for wrapping food, especially cooked rice, when it is necessary to carry a lunch. There are many varieties of bananas, distinguished chiefly by the size, shape, color, and flavor of their fruits. Blanco said that there were fifty-seven varieties known in the Philippines. Some of the commonest varieties of bananas sold in Manila are the tundan, the gloria, the sabá, the lacatan, the morado, and the cariñosa.[32] *Musa textilis* Née, the source of the valuable fiber known as abacá, or Manila hemp, is an endemic species.

CANNACEÆ

Canna indica L.; canna, ticas ticas. A native of tropical America; many varieties are grown in the Philippines as ornamental plants.

[32] Teodoro, N. G., Philip. Journ. Sci. § C 10 (1915) 379–418, describes the commoner species and varieties of bananas growing in the Philippines. Fawcett, The Banana, its Cultivation Distribution and Commercial Uses. London, Duckworth and Co. (1913), enumerates 66 species of *Musa*, but there are many more kinds if varieties and cultural forms be considered.

MARANTACEÆ

Maranta arundinacea L.; arrowroot, arurú. Genus and species of tropical America; introduced in the Philippines at an early date and cultivated to a small extent; a source of food.

PIPERACEÆ

Piper betle L.; betel pepper, icmo. Common in cultivation and wild throughout the Philippines, probably introduced; the leaves are chewed with the fruit of *Areca catechu* and lime.

MORACEÆ

Ficus elastica Roxb.; fig, india-rubber tree, banyan. Introduced from India; a shade tree.

Artocarpus communis Forst.; bread fruit, rimas, camansi. Several varieties of this species in Malaya and Polynesia, not indigenous to the Philippines; cultivated for the fruit, which is eaten.

Artocarpus integrifolia L. f.; jack fruit, nanca. India to Malaya, certainly introduced in the Philippines; the fruit is eaten raw and as a preserve.

NYCTAGINACEÆ

Bougainvillea spectabilis Willd. A showy ornamental vine, native of Brazil.

MAGNOLIACEÆ

Michelia champaca L.; champaca. Introduced from India or Malaya, not spontaneous; a small tree, valued because of its fragrant flowers, which are a source of perfume.

ANNONACEÆ

Annona muricata L., soursop, guaiabano; *A. reticulata* L., custard apple, anonas; *A. squamosa* L., sugar apple, ates. These three species are natives of tropical America; they were introduced into the Philippines and are now widely cultivated for their edible fruits.

LAURACEÆ

Persea americana Mill.; alligator pear, avocado. A native of tropical America from whence it was introduced by the Spaniards before 1700. In 1903 it was again introduced, from Honolulu, Hawaii. It is highly prized for its fruit.

LEGUMINOSÆ

Samanea saman Merr.; acacia, rain-tree. A native of the West Indies; a very common shade tree.

Pithecolobium dulce Benth.; camonsil, camanchiles. A native of tropical America, now thoroughly naturalized in the Philippines; a common source of tan bark; the fleshy arils are eaten.

Acacia farnesiana Willd.; aroma. Probably a native of tropical America; abundant in waste places and thoroughly naturalized; in many places one of the commonest shrubs invading grasslands.

Leucaena glauca Benth.; ipil-ipil, malaganit. A native of tropical America; thoroughly naturalized; a source of firewood in the Philippines.

Mimosa pudica L.; sensitive plant, macahia. A native of tropical America, now a widely distributed weed of all tropical countries.

Caesalpinia sappan L.; sappang. India and Malaya, probably introduced in the Philippines; a source of dyewood.

Delonix regia Raf.; fire tree, poinciana, caballero, arbol del fuego. A native of Madagascar and tropical Africa, cultivated as an ornamental tree in the large towns of the Archipelago; probably introduced about the middle of the nineteenth century.

Tamarindus indica L.; tamarind, sampaloc. Commonly cultivated for its edible fruit; its introduction prehistoric; probably a native of tropical Africa.

Arachis hypogaea L.; peanut, mani. A native of tropical America, now cultivated in the Philippines; the source of the well-known peanut.

Indigofera suffruticosa Mill. and *I. tinctoria* L.; indigo, tayom. Both species are natives of tropical America and were formerly extensively cultivated in the Philippines as a source of indigo.

Gliricidia sepium Steud.; madre cacao. A native of Mexico, introduced at an early date and now thoroughly naturalized in the Philippines; much used in hedges and for fence posts.

Sesbania grandiflora Pers.; caturay. Certainly not indigenous, but its introduction prehistoric; valued for its resin and edible flowers.

Phaseolus lunatus L.; lima bean, patani. A native of tropical America; cultivated for its edible beans.

Vigna sesquipedalis L.; cowpea, sitao. Probably a native of China; cultivated for its edible pods and beans.

Phaseolus radiatus L.; green gram, mungos. A native of the Old World; introduced here and cultivated as a source of food.

OXALIDACEÆ

Averrhoa bilimbi L., camias; *A. carambola* L., balimbing. Both are natives of tropical America; cultivated for their acid edible fruits.

RUTACEÆ

Citrus maxima Merr.; pomelo, lucban, suha. A native of Malaya and Polynesia; cultivated throughout the Philippines for its fruit.

Citrus aurantium L., cahel; and *C. nobilis* Lour., naranjita. Extensively cultivated for their valuable fruits; probably introduced.

Citrus aurantifolia Swingle; limon, dayap. India and Malaya; undoubtedly of prehistoric introduction in the Philippines, where it is cultivated for its fruit.

MELIACEÆ

Sandoricum koetjape Merr.; santol. India to Malaya, undoubtedly introduced in the Philippines; cultivated for its edible fruit, and also naturalized in some regions.

Aglaia odorata Lour.; cinamomo de China. A small tree, commonly cultivated for its fragrant flowers; a native of southeastern Asia.

EUPHORBIACEÆ

Euphorbia tirucalli L.; consuelda. A leafless ornamental shrub or small tree, with green branches; a native of Africa.

Euphorbia heterophylla L.; painted leaf. An herb; native of temperate and tropical America; grown for ornamental purposes.

Euphorbia pulcherrima Willd.; pascuas, poinsettia. A native of tropical America; grown for ornamental purposes.

Jatropha curcas L.; physic nut, tuba. A native of tropical America; thoroughly naturalized in the Philippines; common in hedges.

Codiaeum variegatum Blume; croton, San Francisco, buenavista. Probably a native of the Moluccas; commonly cultivated as an ornamental foliage plant.

Acalypha hispida Burm. An introduced ornamental shrub; probably a native of Malaya or Polynesia.

Acalypha wilkesiana Muell.-Arg. A native of Fiji Islands; an ornamental shrub with variously colored leaves.

Ricinus communis L.; castor-oil plant, tañgan-tañgan. Probably a native of tropical Africa and of prehistoric introduction into the Philippines; the seeds are used as a medicine; the source of castor oil.

Manihot utilissima Pohl; tapioca plant, cassava, camoting cahoy. A native of tropical America; the roots are used for food.

ANACARDIACEÆ

Anacardium occidentale L.; cashew nut, casoy. Introduced from tropical America at an early date; cultivated for its edible fruit.

Mangifera indica L.; mango, manga. A native of India or Malaya; cultivated throughout the Tropics for its splendid fruit.

Spondias purpurea L.; ciruela. A native of tropical America; introduced into the Philippines at an early date; valued here for its plumlike fruit.

BALSAMINACEÆ

Impatiens balsamina L.; balsam, balsamina, camantigui. A native of British India; cultivated for medicinal and ornamental purposes.

MALVACEÆ

Hibiscus sabdariffa L.; roselle. A native of India; recently introduced in the vicinity of Manila and cultivated for its edible fruit.

Hibiscus rosa-sinensis L.; probably a native of southeastern Asia; *H. mutabilis* L., a native of China; and others are commonly cultivated as ornamentals and for hedges.

Gossypium brasiliense Macf.; cotton, algodon, bulac castila. A native of Brazil; cultivated as an ornamental in Manila and for the fiber in the provinces.

BOMBACACEÆ

Ceiba pentandra Gaertn.; silk-cotton tree, kapok. Probably a native of tropical America; the short silky fiber is used for pillows and mattresses.

STERCULIACEÆ

Theobroma cacao L.; chocolate, cacao. A native of tropical America; introduced by the Spaniards at an early date and now cultivated in many parts of the Philippines; the source of chocolate.

BIXACEÆ

Bixa orellana L.; anatto, achuete. A native of tropical America; cultivated throughout the Philippines; the seeds yield anatto dye.

CARICACEÆ

Carica papaya L.; papaya. Introduced from Mexico by the Spaniards at an early date; common in cultivation and frequently spontaneous; edible fruit.

PUNICACEÆ

Punica granatum L.; pomegranate, granada. Introduced by the Spaniards at an early date and cultivated as an ornamental shrub; a native of eastern subtropical Asia.

MYRTACEÆ

Eucalyptus tereticornis Sm.; blue gum. A native of Australia; occasionally cultivated in Manila as a shade tree.

Psidium guajava L.; guava, guayaba, bayabas. A native of Mexico; now thoroughly naturalized in the Philippines; it produces excellent firewood and an edible fruit.

ARALIACEÆ

Nothopanax fruticosum Miq.; papua. Probably of prehistoric introduction here; a native of Malaya or Polynesia; cultivated as an ornamental shrub.

SAPOTACEÆ

Achras sapota L.; chico. Introduced from Mexico by the Spaniards at an early date; now found in all parts of the Archipelago; cultivated for its edible fruit.

OLEACEÆ

Jasminum sambac Ait.; jasmine, sampaguita. A native of India; now cultivated in many tropical countries; valued for its fragrant white flowers.

CONVOLVULACEÆ

Ipomoea cairica Sweet, a native of northern Africa, very commonly cultivated as an ornamental for covering walls, porches, etc., also spontaneous; *I. nil* Roth, a native of tropical America; *I. pes-tigridis* L., a native of tropical Africa and Asia; *I. purpurea* L., morning glory, a native of tropical America; *I. triloba* L., introduced from tropical America; *I. batatas* Poir, sweet potato, camote, a native of tropical America.

LABIATÆ

Rosmarinus officinalis L.; rosemary, romero. Introduced from Spain; a source of medicine.

Mentha arvensis L.; mint, yerba buena. Introduced from Europe; cultivated for its aromatic leaves.

SOLANACEÆ

Datura alba Nees; talong punay. India to China and Malaya; widely distributed and spontaneous in the Philippines, where it undoubtedly has been introduced; used in medicine.

Cestrum nocturnum L.; dama de noche. A native of tropical America; introduced here at an early date; cultivated for its fragrant flowers.

Nicotiana tabacum L.; tobacco, tabaco. A native of tropical America; introduced here at an early date and now extensively cultivated; the source of tobacco.

Lycopersicum esculentum Mill.; tomato, tomate, camatis. A native of tropical America; spontaneous and cultivated in the Philippines; valued for the edible fruit.

Capsicum frutescens L.; Chile pepper, Chile, pasites, sili. A native of tropical America; now wild and cultivated in all parts of the Philippines; the fruit is used as a condiment.

RUBIACEÆ

Coffea arabica L.; coffee, café. A native of southwestern Asia; now cultivated in most tropical countries as a source of the coffee bean.

Ixora finlaysoniana Wall., probably a native of Siam; *I. coccinea* L., a native of India; *I. chinensis* Lam., a native of tropical Asia. Ornamental shrubs.

CUCURBITACEÆ

Cucurbita maxima Duchesne; squash, calabaza. Probably a native of tropical America; cultivated for its edible fruit.

Luffa cylindrica Roem.; sponge gourd, patola. Native country uncertain; cultivated for its edible fruit.

Citrullus vulgaris Schrad.; watermelon, sandia, pacuan. A native of tropical Africa; a vine, cultivated for its edible fruit.

Cucumis melo L.; melón. A native of tropical Asia or Africa; a vine, cultivated for its edible fruit.

COMPOSITÆ

Artemisia vulgaris L.; camaria, damong maria. A native of Europe and Asia, introduced from Europe for medicinal use.

In addition to the preceding introduced plants, most of which are of much or considerable economic value, there are numerous grasses, herbs, and shrubs that have been introduced inadvertently and now persist as weeds. I shall not enumerate any of these. It must be clear that the plants found in the vicinity of Manila are far from being typical of the endemic flora.

DESTRUCTION OF THE INDIGENOUS FOREST

Dr. H. N. Whitford, formerly forester in the Philippine Bureau of Forestry, was much interested in the types of forest vegetation and in 1906 wrote a paper on this subject. Five years later he published the results of his investigation of the entire Archipelago or so much of it as had been examined from the forester's viewpoint.

Mr. E. D. Merrill, botanist of the Philippine Bureau of Science, has traveled over a large part of the Archipelago and has studied Philippine plants as a botanist since 1902.

The opinions of these two authors with regard to Philippine forests are entitled to respectful consideration, and indeed it seems unlikely that anyone who has considered the subject in the light of field experience will question the conclusions in the following quotations:

Whitford [33] says:

There is little question that practically the entire land area of the Philippines, from sea level to the highest mountains, was originally covered with unbroken forest growth of some kind.

Merrill [34] says:

It is practically certain that before the advent of man in the Philippines, the entire country was covered with unbroken forest, of one kind or another, from sea-level to the tops of the highest mountains, except, perhaps, where the vegetation had been temporarily destroyed by natural causes, such as volcanic eruptions. Such types of vegetation as the extensive grass-covered hills, mountain sides, and plains, and the open cultivated areas, now such prominent features in the landscape, did not originally exist, so that the whole aspect of many localities must have been quite different from what it is to-day and from what has been its condition within historic times. When we consider that about two-thirds of the entire land surface of the Archipelago consists of cultivated areas, open grass lands, thickets, and second-growth forests, and that all these types of vegetation are due directly or indirectly to the presence of man, some idea can be obtained of the profound changes that have been wrought in the vegetation of the country in past centuries.

The earliest inhabitants—presumably the Negritos [35]—were not skilled in any kind of agriculture and were not numerous enough to have been an important factor in the extermination of the coastal and other lowland forest. With the increase in population by the advent of the tribes that are now the Christian Filipinos, the cultivation of rice was introduced or, at any rate, much extended in the lowlands. This necessitated the clearing of large areas of level or nearly level land. If the population of an island increased, the area of cleared land was increased, until in some of the islands there was no new level land to be brought under wet-rice culture. In such cases some of the surplus population migrated to other islands or pushed into the hills and raised upland rice, which matures without irrigation and, therefore, can be grown on steep slopes. Even rice that requires much irrigation can be grown on steep mountain sides where level areas are made by means of retaining walls, as in many parts of Mountain Province, Luzon.[36] This method of cultivation is not practiced in the lowlands. All of this clearing means the destruction of forest; and other uses for wood, such

[33] Bull. P. I. Bur. Forestry 10 [1] (1911) 12.

[34] Philip. Journ. Sci. § C 7 (1912) 149.

[35] See Reed, Wm. A., Negritos of Zambales, Ethnol. Surv. Publ. 2 [1] (1905) 1–83, 62 pls., 2 figs.

[36] See Jenks, A. E., The Bontoc Igorot, Ethnol. Surv. Publ. 1 (1905) 266 pp., 145 pls., 9 text figs.; and Worcester, D. C., The non-Christian tribes of northern Luzon, Philip. Journ. Sci. 1 (1906) 791–876, 47 pls.

as cooking and house and boat construction, play their parts in thinning the forest near large towns.

A method of agriculture common to various tropical countries is also practiced in the Philippines, where it is known as the caiñgin system. The caiñgin is merely a clearing in the forest, and if this were continuously cultivated no harm would result.[37] The caiñgin is seldom thoroughly cleared; the smaller trees are cut and when dry are burned. Nearly all of the large trees in the field are killed in this process. A crop of corn, rice, sweet potatoes, or yams is now planted. For a few seasons good crops can be taken off a caiñgin without much labor, but grass soon becomes so well established that the farmer finds it easier to make a new caiñgin than to struggle with the grass.

In the part of the Archipelago having distinct wet and dry seasons, that is, the western half, grass areas tend to remain in grass. The grass is frequently burned during the dry season, either by accident or intention, and this kills any forest-tree seedlings that have entered the grass, while the deep-seated perennial rhizomes of the grasses are uninjured. After the first rain the grass soon produces a luxuriant growth. On the eastern side of the Islands there is a nearly continuous wet season. Here the more uniformly moist condition prevents grass fires and the grassland is soon invaded by tree species and gradually returns to forest.[38]

If the population of a thickly inhabited island decreases, which has undoubtedly happened as the result of war or epidemic disease, some of the rice fields will be abandoned. These, even when bordering forest, do not grow up to the old forest species of trees, but first with a rank grass and later with species of shrubs and second-growth trees. If this be in the region of marked wet and dry seasons, it will be very difficult for the forest species to regain a foothold in an area from which they have been removed.[39]

[37] See Merrill, E. D., Philip. Journ. Sci. § C 7 (1912) 149.

[38] With regard to the soils and the climate of the Philippines see Cox, A. J., Philip. Journ. Sci. § A 6 (1911) 279–330; also Brown, W. H., and Matthews, D. M., ibid. § A 9 (1914) 417.

[39] With regard to revegetation in the Philippines see: Gates, F. C., The pioneer vegetation of Taal Volcano, Philip. Journ. Sci. § C 9 (1914) 391–434, 8 pls.; Brown, W. H., and Matthews, D. M., Philippine dipterocarp forests, ibid. § A 9 (1914) 413–562, 13 pls., 1 map, 12 figs.; Merrill, E. D., Brown, W. H., and Yates, H. S., The revegetation of Volcano Island, Luzon, Philippine Islands, since the eruption of Taal Volcano in 1911, ibid. § C 12 (1917) 177–248, 16 pls., 2 figs.

In some localities the clearing of land for planting coconuts, bananas, abacá, corn, and rice is an important factor in the destruction of the original vegetation. It is probable that the destruction of the original forest to make room for commercial plantations is in progress, more or less, over the entire Eastern Tropics. In this connection Merrill says:[40]

It is only necessary to examine most parts of Java below an altitude of 4,000 feet, such islands as Singapore, immense areas in the Malay Peninsula, and the settled areas generally in the whole Malayan region in order to gain some appreciation of the disastrous effects of man's activities on the floras of these regions. It is a well-known fact that where the virgin, or primary, forest is once destroyed in the Eastern Tropics, the areas practically never revert to the original type of vegetation, at least in any reasonable amount of time. If the cleared lands are abandoned, as they frequently are by the primitive native agriculturist, they are quickly occupied by grass formations, usually lalang (*Imperata*), bamboo formations, or complex second-growth forests in constituent species entirely different from the primary, or virgin, type. The pressure on the primary forest is rapidly increasing in many parts of Malaya, not only by the increase in the native Malay population, and the resultant demand for more agricultural lands, but also in the demands of modern industries for increased production in such commodities as rubber and copra and for other tropical products such as sugar, tobacco, fibers, coffee, tea, and other staples. Since the beginning of the present century immense areas in the Malay Peninsula, in Sumatra, in the Philippines, and doubtless in Borneo and in other parts of Malaya have been denuded of their original vegetation to provide place for modern plantations, and it is safe to assume that most such areas will never again be occupied by primary forests. The shade plants and enormous trees characteristic of the primary forest cannot persist under the conditions demanded by modern agriculture, and they cannot exist in the second-growth forests, grasslands, and bamboo thickets that rapidly encroach on cleared areas that are abandoned. Perhaps without realizing the fact we are witnessing in our own generation the rapid extermination of some of the noblest types of tropical vegetation, and all botanists should be interested in preserving at least herbarium records while such records are to be secured. The present century will certainly witness an enormous extension of the agricultural areas in Malaya, for modern science has rendered our "conquest of the Tropics" a comparatively simple matter; and any general extension of agricultural areas will to a large degree be at the expense of regions now covered with forests of one type or another.

Shelford[41] notes that—

* * * even in Sarawak, that peaceful backwater of civilization, there have been notable alterations in the land fauna in the neighborhood

[40] Merrill, E. D., A bibliographic enumeration of Bornean plants. Introduction. MS.

[41] Shelford, R. W. C., A naturalist in Borneo. E. P. Dutton and Co., New York (1917) 294.

of towns and of Government stations within the last twenty-five years, whilst the natives themselves, by their extravagant system of cultivation, whereby tracts of jungle are annually destroyed, must be responsible in the long run for the extermination of many species.

TYPES OF PHILIPPINE FORESTS

Vegetation is such an important factor in the distribution of birds that it is necessary to consider in some detail the various types of Philippine forest. Most of my information concerning forests is condensed from Whitford [42] wherever it is not quoted exactly from him or from other authors. As already stated it is believed that practically the entire area of the Islands was at one time covered with forest. The extent of the change brought about by man is shown by estimates of the Philippine Bureau of Forestry, given here as Table 1.

TABLE 1.—*Areas of various types of vegetation in the Philippine Islands.*

	Square miles.	Per cent.
Virgin forest	40,000	33⅓
Second-growth forest	20,000	16⅔
Grassland	48,000	40
Cultivated land	12,000	10
Total	120,000	100

Whitford says:

> Put in another way, the land area of the Philippines is about equal to that of the State of New Mexico, while the virgin forest is approximately equal to the entire area of the State of Kentucky. [p. 13.]

George P. Ahern, for many years director of the Philippine Bureau of Forestry, was enthusiastic over the variety of tree species in the native forest. In one of the Government publications he says:[43]

> One can not realize the richness of the tree flora of the Philippine Islands until he is told that there have already been found over two thousand kinds in the Philippine Islands. This means more to the average person when it is known that this is probably three times as many varieties as have been found in the United States. When all is known concerning the tree flora of the Philippines it is probable that this number will reach three thousand. Of course it must be stated that all of these are not used commercially.

According to Whitford [44] there are one hundred six species of Philippine trees the lumber from which finds a place of some

[42] The forests of the Philippines, Bull. P. I. Bur. Forestry 10[1] (1911) 94 pp., 24 pls.

[43] A few pertinent facts concerning the Philippine forests, P. I. Bur. Forestry Circular 3 (1908) 9.

[44] Bull. P. I. Bur. Forestry 10[1] (1911) 9, 10.

prominence in the markets, but the number of species that are of no value for lumber is so much greater that the timber trees seem few in comparison. On any given tract the merchantable kinds of trees are not likely to exceed twenty. While a tract may contain two hundred tree species, nine-tenths of them will be of species that never reach a size suitable for lumber. Whitford says that "the largest tree measured to date shows 61 meters (200 feet). Very few species will reach a diameter of more than 180 centimeters (6 feet), measured above the root buttresses."

The species of trees in the Philippines and in the Tropics in general are very different from those of temperate-zone forests. Conifers appear only with elevation. In the Philippines the pine type of vegetation is estimated to be only 5 per cent of the total forested area; it is confined to parts of Luzon and of Mindoro.

A very large area of the forests, about 75 per cent, is characterized by various species of dipterocarps. The trees of this family yield a great variety of commercial wood suitable for many purposes. Whitford says:

> Throughout the work [Whitford's book] emphasis has been laid on the importance of the dipterocarp family; for in spite of the richness of the Philippines in fine furniture wood, the real wealth of their forests consists of construction timbers, such as are represented by the lauans, apitongs, and yacals—all belonging to the dipterocarp family.[45] It is estimated that the dipterocarps include about 144 out of a total of the 200 billion board feet of standing timber in the Islands. Not only is the total amount great, but the members of this family occur in stands sufficiently heavy to be exploited by the use of machinery. The predominance of this family needs emphasis because it is the general belief that the Philippines and the Tropics in general produce only wood of the mahogany and teak grades. [p. 9.]

Whitford recognizes six major types of forest, each of which is characterized by certain tree species. In abstracting the characters of these types as given by Whitford I have omitted much of the detail and have treated his five dipterocarp types as one. I have also arranged the types in what seems a logical order, beginning with the mangrove and ending with the mossy forest. Each of the six types is characterized by certain conspicuous species of plants. There are forests that do not have the characters of any one type, but in general these divisions

[45] See Foxworthy, F. W., Philip. Journ. Sci. § C 6 (1911) 231–287, pls. 34–44, and 13 (1918) 163–197, for the classification of Philippine dipterocarps.

can be distinguished; namely, mangrove, beach, dipterocarp, molave, pine, and mossy forest.

The mangrove forest is distinct; it is important as a source of firewood and tanbark and is interesting because of its plants, but it harbors few birds. The beach forest has been largely destroyed and is of little interest for its birds. The dipterocarp forest covers the largest area and is the most important as a source of lumber; all of its birds and plants are of much interest. Much of the molave forest has been destroyed; zoölogically it scarcely differs from the dipterocarp forest. The pine forest is found in restricted areas in Luzon and Mindoro. The mossy forest is found on several islands at high altitudes; its trees are almost worthless for lumber. The species of plants and animals of the pine forest and the mossy forest are much fewer than those of the dipterocarp forest, but they are of very great interest to the naturalist.

MANGROVE TYPE OF FOREST

The mangrove type is literally a forest in the sea. Where conditions are favorable it occupies beaches washed by the tides. It is especially well developed on mud flats at the mouths of rivers that enter the sea at the heads of protected bays. Wherever wave action allows a fairly stable shore line, trees of this type are present. They occur on the quieter portions of coral reefs and may be the only indication of slightly submerged reefs; in such cases what appear at a distance to be forested islands are found to have no land exposed except perhaps at the lowest tides. Most of the trees in mangrove forests belong to the family Rhizophoraceæ and include the following species:

Rhizophora mucronata Lam.
Rhizophora conjugata Linn.
Bruguiera gymnorhiza Lam.
Bruguiera eriopetala W. & A.
Bruguiera cylindrica (Linn.) Blume.
Bruguiera parviflora W. & A.
Ceriops tagal C. B. Rob.

Species of other families that are characteristic of the mangrove type of vegetation include:

Sonneratia pagatpat Blanco.
Avicennia officinalis Linn.
Lumnitzera littorea (Jack.) Voigt.
Xylocarpus moluccensis (Lam.) M. Roem.
Xylocarpus granatum Koen.
Excoecaria agallocha Linn.
Heritiera littoralis Dry.

Although this type of forest, from the nature of its habitat, is free from undergrowth it is difficult to make one's way through a typical stand because of the complex and tangled system of stilt roots of the species of *Rhizophora*, the dominant species in these

swamps, and also because of the soft mud forming the substratum. At the upper limits of the mangrove there may be a fringe of the nipa palm, *Nipa fruticans* Wurmb, and this palm is inclined to form extensive thickets on low land along streams where the water is only slightly brackish.[46]

BIRDS OF THE MANGROVE FOREST

Few if any species of birds are characteristic of the mangrove forest. I have spent much time among these curious trees in fruitless efforts to discover something startling in birds, but nothing was ever found that could not have been collected elsewhere. Several species of kingfishers, the ever-present flycatcher *Rhipidura nigritorquis* Vigors, the little migratory warbler *Acanthopneuste borealis* (Blasius), and the migratory starling *Sturnia philippensis* (Forster) are among the land birds that can be found in mangroves. The curious little muscicapine species *Gerygone simplex* Cabanis seems to have a predilection for rhizophoraceous trees, but I have found it in other stations as well; for example, in bamboo thickets on the borders of Lake Bay. Near Puerto Princesa, Palawan, I collected specimens of the exquisite, endemic sunbird *Æthopyga shelleyi* Sharpe in mangroves, but they were attracted there by the flowers and are not ordinarily found in this type of forest.

BEACH TYPE OF FOREST

Sandy beaches above the limits of high tide usually have been cleared and are occupied by towns or are planted to coconuts. Where this has not occurred there is a distinct type of forest in which the following trees are found:

Terminalia catappa Linn.
Erythrina indica Lam.
Barringtonia speciosa Forst.
Hibiscus tiliaceus Linn.
Pongamia pinnata Merr.
Thespesia populnea Corr.
Heritiera littoralis Dry.
Calophyllum inophyllum Linn.
Casuarina equisetifolia Linn.
Pemphis acidula Forst.

Some of these species, for example, the *Barringtonia* and the *Casuarina*, may occur in more or less extensive pure stands as a result of favorable soil and other conditions, while some of the more valuable timber trees of other types, such as ipil, narra, and bansalaguin, may be mixed in the beach type.

BIRDS OF THE BEACH FOREST

In most islands much of the beach type of forest has been cleared away, and coconut groves are more or less mixed with

[46] See also Brown, W. H., and Fischer, A. F., Bull. P. I. Bur. Forestry 17 (1918). [Published in 1919.]

what remains. It is difficult to determine if there is any endemic species of bird that is confined to the beach type; probably there is none. I believe that the tabon, *Megapodius cumingi* Dillwyn, which is nearly endemic, is perhaps confined to the beach forest under normal conditions. The following are more or less characteristic of the beach forest, although none of them is confined to it:

Gallus gallus (Linnæus).
Lalage niger (Forster).
Oriolus acrorhynchus Vigors.
Hypothymis occipitalis (Vigors).
Cyornis philippinensis Sharpe.
Copsychus mindanensis (Boddaert).
Lamprocorax panayensis (Scopoli).
Sarcops calvus (Linnæus).
Corvus philippinus Bonaparte.

Various species of *Otus, Loriculus, Caprimulgus, Iole, Macronous, Orthotomus, Zosterops, Æthopyga, Leptocoma, Cyrtostomus,* and *Anthreptes* are also found in the beach forest.

DIPTEROCARP TYPE OF FOREST

The dipterocarps are the most important trees of the Philippine forests. They comprise seventy species in nine genera;[47] and, while some of the species are so rare as to be inconspicuous as individual trees and negligible for commercial purposes, trees of many of the species are numerous enough to be very important. The genera are *Isoptera, Balanocarpus, Dipterocarpus, Anisoptera, Parashorea, Pentacme, Shorea, Hopea,* and *Vatica.* The lumber from different species is adapted to different uses and is marketed under many trade names.

Whitford divides the dipterocarp forests into five types, each of which is characterized by certain dominant dipterocarps and by species of other families. It is not necessary to consider each of these types here. The dipterocarp types cover 75 per cent of the virgin forest of the Philippine Islands or about 30,000 square miles and contain 95 per cent of the standing timber. They are found on all kinds of topography from immediately behind the beach type to 800 meters' altitude on the slopes of the largest mountains.

Practically all the species of the dipterocarps are large trees, reaching heights of 40 to 50 meters and diameters of 100 to 150 centimeters or more, and it is not rare to find even these dimensions exceeded. They have straight, regular boles, resembling in size and shape the *Liriodendron tulipiferum* (yellow poplar or tulip tree) of the United States. Some species of other families have a size and form similar to and [are]

[47] See Foxworthy, F. W., Philip. Journ. Sci. § C 13 (1918) 163–200, 2 pls.; and Brandis, D., Journ. Linn. Soc. Bot. 31 (1895) 1–148, on the dipterocarps of India.

codominant with the dipterocarps, but by far a greater majority are subdominant species, some of which have ill-formed boles, much smaller in diameter and length. Underneath the dominant and subdominant species are a large number of undergrowth tree species which do not attain more than 10 centimeters in diameter when mature, and a height of 10 meters or less. From a botanical point of view, these add greatly to the complexity of the forests, but for commercial considerations they should be called undergrowth trees. Within the forests there are comparatively few shrubs, or bushes, and herbs.

All the types of dipterocarp forests contain climbing palms (rattans), but the number and size of other large vines (lianas) seem to diminish with the prominence of the dipterocarps. Artificial and natural openings in the forests are often covered with a jungle of climbing bamboos and other large lianas, and the edges of the forests especially along streams, present breast-works of twisted vines which are very difficult to penetrate; but as soon as the interior is reached it is easy to pass through the forest with only the occasional use of a bolo (machete).[48]

Dipterocarp forests are best developed on well-watered plains or on the lower slopes of large mountains. Here the soil is usually a deep loamy clay of volcanic origin; passing to drier soils of calcareous origin the dipterocarp species give way and the forest becomes more open, usually dominated by such species as molave, *Vitex parviflora* Jussieu. As higher elevations are reached the trees become smaller and the dipterocarps less numerous. At 800 meters or less this type gives way to one in which miscellaneous trees—*Quercus* and other genera—are more prominent.[49]

Brown[50] has written a careful description of the forests of Mount Maquiling, Laguna Province, Luzon, in which is included a vast amount of detailed and exact information. The volume and the composition of the forest at different altitudes are given with great care, and the book is a unique study of tropical vegetation.

MOLAVE TYPE OF FOREST

Molave, *Vitex parviflora* Jussieu, is fairly well distributed throughout the forest that is designated the molave type. It is found typically on low limestone hills, which are usually composed of crystalline coral limestone with a honeycomb structure. These rocks are generally covered by shallow or scanty soil. The habitat is very dry. A large part of the molave type has

[48] Whitford, H. N., Bull. P. I. Bur. Forestry 10[1] (1911) 18.

[49] See Brown, W. H., and Matthews, D. M., Philip. Journ. Sci. § A 9 (1914) 416.

[50] Vegetation of Philippine Mountains. Bureau of Science, Manila (1919) 434 pp., 41 pls.

been destroyed. In its virgin state it is open, with its large trees few and far apart; the intervening spaces are filled with small trees or by a jungle of sprawling, climbing, and small erect bamboos. In some expressions of this type the dominant trees include:

Vitex parviflora Juss.
Tarrietia sylvatica Merr.
Sindora supa Merr.
Kingiodendron alternifolium Merr.
Intsia bijuga O. Ktz.
Albizzia acle Merr.
Wallaceodendron celebicum Koord.
Zizyphus zonulata Blanco.
Pterocarpus echinatus Pers.
Aglaia clarkii Merr.

Among the smaller species there may be:

Maba buxifolia Pers.
Diospyros discolor Willd.
Taxotrophis ilicifolia Vid.
Cassia javanica Linn.
Pterospermum spp.
Mallotus floribundus Muell.-Arg.

WALLACE ON THE TROPICAL FOREST

The lowland tropical forest was described in popular language years ago by Wallace. He says (pp. 240–244) :[51]

> It is not easy to fix upon the most distinctive features of these virgin forests, which nevertheless impress themselves upon the beholder as something quite unlike those of temperate lands, and as possessing a grandeur and sublimity altogether their own. * * *
>
> The observer new to the scene would perhaps be first struck by the varied yet symmetrical trunks, which rise up with perfect straightness to a great height without a branch, and which, being placed at a considerable average distance apart, give an impression similar to that produced by the columns of some enormous building. Overhead, at a height, perhaps, of a hundred and fifty feet, is an almost unbroken canopy of foliage formed by the meeting together of these great trees and their interlacing branches; and this canopy is usually so dense that but an indistinct glimmer of the sky is to be seen, and even the intense tropical sunlight only penetrates to the ground subdued and broken up into scattered fragments. There is a weird gloom and a solemn silence, which combine to produce a sense of the vast—the primeval—almost of the infinite. It is a world in which man seems an intruder, and where he feels overwhelmed by the contemplation of the ever-acting forces which, from the simple elements of the atmosphere, build up the great mass of vegetation which overshadows and almost seems to oppress the earth.
>
> Passing from the general impression to the elements of which the scene is composed, the observer is struck by the great diversity of details amid the general uniformity. Instead of endless repetitions of the same forms of trunk such as are to be seen in our pine, or oak, or beechwoods, the eye wanders from one tree to another and rarely detects two together of the species. All are tall and upright columns, but they differ from each other more than do the columns of Gothic, Greek, and Egyptian

[51] Wallace, A. R., Natural Selection and Tropical Nature. Essays on descriptive and theoretical biology, new edition, with corrections and additions. Macmillan and Co., London and New York (1895).

temples. Some are almost cylindrical, rising up out of the ground as if their bases were concealed by accumulations of the soil; some get much thicker near the ground like our spreading oaks; others again, and these are very characteristic, send out towards the base flat and wing-like projections. These projections are thin slabs radiating from the main trunk, from which they stand out like the buttresses of a Gothic cathedral. They rise to various heights on the tree, from five or six to twenty or thirty feet; they often divide as they approach the ground, and sometimes twist and curve along the surface for a considerable distance, forming elevated and greatly compressed roots. These buttresses are sometimes so large that the spaces between them if roofed over would form huts capable of containing several persons. Their use is evidently to give the tree an extended base, and so assist the subterranean roots in maintaining in an erect position so lofty a column crowned by a broad and massive head of branches and foliage. Aërial-rooted forest trees * * * and the equally remarkable fig-trees of various species, whose trunks are formed by a miniature forest of aërial roots, sometimes separate, sometimes matted together, are characteristic of the Eastern tropics, * * *. The leaves of the Asiatic caoutchouc tree (Ficus elastica), so often cultivated in houses, is a type of this class (trees with large, thick, and glossy leaves), which has a very fine effect among the more ordinary-looking foliage. Contrasted with this is the fine pinnate foliage of some of the largest forest trees, which, seen far aloft against the sky, looks as delicate as that of the sensitive Mimosa. The great trees we have hitherto been describing form, however, but a portion of the forest. Beneath their lofty canopy there often exists a second forest of moderate-sized trees, whose crowns, perhaps forty or fifty feet high, do not touch the lowermost branches of those above them. * * * Yet beneath this second set of medium-sized forest trees there is often a third undergrowth of small trees, from six to ten feet high, of dwarf palms, of tree-ferns, and of gigantic herbaceous ferns. Yet lower, on the surface of the ground itself, we find much variety. More frequently it is covered with a dense carpet of selaginella or other lycopodiaceae, and these sometimes give place to a variety of herbaceous plants, sometimes with pretty, but rarely with very conspicuous flowers.

BIRDS OF THE LOWLAND FORESTS

In the lowlands of any island it is the old uncut forest, more or less similar in character to the tropical forests described by Wallace or the dipterocarp and molave forests described by Whitford and by Brown, that will harbor the endemic species of birds if there be any. Unless it is desired to accumulate a series of specimens of widely distributed species, it is almost a total waste of time to collect in grassland or second-growth thickets.

In investigating the avifauna of an island that is ornithologically unknown, the main effort should be expended in reaching primary, uncut forest [52]—on level ground, if possible, and as

[52] By primary forest I mean the original natural forest of the lowland in distinction from grassland, second-growth thickets, coconut trees and other planted vegetation, the beach type, and the mangrove forest.

clear of undergrowth as may be—but, hilly or level, the primary forest is almost the only vegetation that will yield local endemic species. Coconut groves must not be overlooked, and some valuable specimens can be found in the beach forest. The parrakeets of the genus *Loriculus* and all or most of the sunbirds feed among the blossoms of the coconut palm, and such forest birds as the small orioles and the fairy bluebirds often feed in small second-growth trees when conditions suit them; but these birds are at home in the primary forest and are attracted to other types of vegetation by abundance of food.

In order to reach primary forest it is usually necessary to pass through areas of grassland, cultivated fields, and thickets. Unless a trail can be utilized, there is often much difficulty in entering the forest, for the borders are usually a thick tangle of grasses, vines, and shrubs.

When the primary forest has been cleared from the level parts of an island, it becomes necessary to search for birds among the trees on more or less steep mountain sides. In such situations there seem to be fewer birds than in forests on level ground, and the difficulty of collecting is increased; this results partly from the less ease with which one can walk and partly from the fact that birds, if killed in trees on hillsides, usually fall much farther from the shooter than they do when killed in trees on level ground and consequently are more frequently lost. So far as I can judge there is little if any difference in the species of birds of the dipterocarp forest, the molave type, and Brown's midmountain forest. The last sort of forest is composed of lower, smaller trees and seems to have fewer species of birds, but these birds are species that are also found in the dipterocarp forest.

Within many forests the ground is nearly clear of undergrowth so that one can wander at will, provided that care is taken to avoid the sharp hooks on the long flagellæ terminating the feathery fronds of rattan palms. If the ground is level, it is an easy matter to become confused as to directions. The light filters through many layers of leafy branches, and the air is damp and cool. No hat is needed even when the heat is dizzying in the open. Much of the time such a forest is absolutely silent. Although the monsoon may be blowing a gale, its effect ceases at the border of the forest. Occasionally a troop of monkeys will suddenly chatter and make a great commotion leaping and crashing from one tree to another. A large cicada

often makes a deafening sound. A woodpecker may make the woods ring with his harsh call or a large hornbill awaken the echoes with his loud weird "au, calau au au;" as he flaps slowly away, his wings produce a curious rustling sound.

Now a familiar bird note may come faintly from the high leafy branches as at a distance—"te-dee, dee dee dee." Wait, it is coming this way. There it is again, and it sounds like a chickadee. No wonder, either, for it really is a chickadee—a fine black and yellow chap, *Pardaliparus elegans* (Lesson) or a related species, that is not very much different from some of its American cousins. That long-tailed nervous thing with a harsh voice is a flycatcher, *Rhipidura cyaniceps* (Cassin); let it go, the branches overhead are full of birds. We are in the midst of one of the wandering bands that are characteristic of the forest. There is a fine male *Cyanomyias cœlestis* (Tweeddale)—a gem among flycatchers; one good specimen of that is worth a day's work. Look carefully for the small quiet ones. The rare species of *Zosterornis* go in these flocks. What is that you have picked out from the end of a high branch? A rare warbler? Yes, rare in North America. That is *Acanthopneuste borealis* (Blasius), one of the worst pests of the collector. It is an abundant migrant in the Philippine Islands, and because of its pale gray and greenish yellow colors it is difficult to identify as it flits among the leaves.

If you have had good luck you have been able to recover two or three good specimens from this flock, which has now passed on its way. Perhaps you have lost as many more, some having lodged in masses of epiphytic plants far from the ground, others being hopelessly buried in a rank growth of ferns. The last you hear of the flock are the calls of the chickadee and the nuthatch as they fade in the distance. The silence is now oppressive, for there is absolutely not a sound.

Where do these wandering bands come from and where do they go? What leads such a variety of kinds to travel together? Here are chickadees, nuthatches, flycatchers, thickheads, silver-eyes—birds of various families, but all insect-eaters. Do they secure any protection by traveling together? It is doubtful if they need it, for hawks cannot work to advantage among the branches of the forest trees. It is possible that these birds take pleasure in each other's company, but that is mere surmise. It seems more probable that several or many birds traveling through the tree tops disturb the insects upon which they feed,

and so all of the members of the band are able to secure more food than if they moved about singly or in pairs.[53]

The following paragraph [54] is in agreement with this idea:

In tropical forests, where insects are everywhere abundant, the birds seemed to have realized the fact that to each is apportioned certain phases of insect life, and that by hunting in large flocks, instead of competition resulting between birds of different species, they play into each other's hands (or rather beaks). It is of such a flock that Hudson writes: "The larger creepers explore the trunks of big trees, others run over the branches and cling to the lesser twigs, so that every tree in their route, from its roots to the topmost foliage, is thoroughly examined, and every spider and caterpillar taken, while the winged insects, driven from their lurking-places, are seized where they settle, or caught flying by the tyrant-birds."

Swynnerton [55] has published an interesting paper on this phase of the bird life of southeast Africa in which he gives us many of his own observations. He quotes Bates [56] as saying that—

The simplest explanation appears to be this: that the birds associate in flocks from the instinct of self-preservation, and in order to be a less easy prey to hawks, snakes, and other enemies than they would be if feeding alone.

Marshall,[57] in a paper on the birds of Mashonaland, seems to agree with Bates. He says:

A fact which must impress every observer is the way in which one may often walk for several miles through likely-looking country and scarcely see a bird; then suddenly one comes upon a troop of them, composed of Drongos, Tits, small Shrikes, Flycatchers, Warblers, and Buntings, keeping more or less together in a limited area. Personally I have little doubt that this may be attributed to the large number of birds of prey which occur here; so that the smaller birds find it advisable to associate as a means of protection, the Drongos acting as a sort of body-guard. My view is supported by the fact that the phenomenon is observed principally in the open forest which characterizes the greater part of the country; while, wherever the bush is more dense and affords better cover, the small birds are more generally distributed.

Swynnerton says that he has seen birds attending a party of monkeys that was moving through the tree tops. He concludes his paper with the following paragraphs:

While, however, I feel that the mixed parties are primarily drives, and the Drongo from this standpoint mainly parasitic, it is, I think,

[53] It is perhaps worth while recording that I had written the above paragraph before I had seen any of the following notes by other authors on the same subject.

[54] Beebe, C. W., The Bird: its Form and Function. Henry Holt and Company, New York (1906) 150.

[55] Swynnerton, C. F. M., Mixed bird-parties, Ibis X 3 (1915) 346–354.

[56] The Naturalist on the Amazons 2 (1863) 334–336.

[57] Marshall, G. A. K., Ibis VII 4 (1900) 222.

likely that the great "mobbing" power afforded by numbers must be so great an advantage as to probably act as a contributing factor. I think, too, that the Drongo, with his boldness and readiness to attack, quite likely fully "pays for his keep."

The fact of systematic co-operative hunting on so large a scale suggests the views on mutual aid amongst animals that have been laid stress on by some Russian naturalists; yet is of *particular* interest as suggesting how keen selection must sometimes be and how baseless, probably, is the view that the more perfect defensive adaptions of insects constitute hypertely.

At another time a family of four or five fiery minivets (*Pericrocotus*) comes into sight. The adult male is brillant red or orange and black, the female and young are yellow and black. The minivets are rare and seem to care little for the company of other birds. The various species of forest orioles (*Oriolus*) and of fairy bluebirds (*Irena*) move about in pairs; they feed among the branches of the tallest trees, and their presence is usually revealed by their characteristic call notes some time before they can be seen.

Few of these forest-inhabiting species are even seen in the open. As Worcester [58] remarks, birds in the Tropics "may be born, grow old, and die within the limits of a single grove, and never suffer want of food or shelter." This seems to account for the fact that many species of birds are confined to single islands, in some cases to very small islands. The species having been developed in a thick forest, the individuals never leave it and have no chance or inclination to extend their range to other islands, however near. Furthermore, in the forest they are perfectly protected from being driven to sea or to other islands by winds, no matter how powerful.

There are many endemic species that are seldom found except when they are feeding at flowering or fruiting trees. Days or even weeks may be spent without an individual of these species being seen; but when a favorite tree is found in flower or fruit it is only necessary to wait nearby, where as many specimens as desired can be collected.

The species of *Dicæum, Prionochilus, Leptocoma, Cyrtostomus, Æthopyga, Iole,* and *Loriculus,* especially, can be obtained in quantities at trees in flower. One tree that is a particular favorite with many species of birds is the dap-dap, *Erythrina indica,* which has large scarlet flowers from January to April; as it usually casts most of its leaves during anthesis the flowers are rendered very conspicuous. Zimmer [59] gives a good picture

[58] Proc. U. S. Nat. Mus. 20 (1898) 581.
[59] Philip. Journ. Sci. § D 13 (1918) 350.

of such a tree at Brooke's Point, Palawan, in the following words:

> At times I have seen parrots, cockatoos, leafbirds, nuthatches, chickadees, woodpeckers, orioles, flowerpeckers, sunbirds of various kinds, spider-hunters, pigeons, and starlings, all in this tree at once, while in nearby foliage were cuckoos, fairy bluebirds, flycatchers, minivets, thrushes, tailorbirds, bulbuls, and the like. The clamor was indescribable, and the conglomeration of assorted colors exhibited by the assemblage and set off by the brilliant blossoms of the tree was most striking and yet harmonious.

Some species of *Ficus* are favorite feeding resorts for doves, parrots, flowerpeckers, sunbirds, etc. Sunbirds and the colasisis (*Loriculus*) are usually more or less abundant in coconut groves. I found *Æthopyga shelleyi* Sharpe in abundance on some flowering trees in a mangrove swamp near Puerto Princesa, Palawan. The imperial pigeons (*Muscadivores*) are very fond of the fruit of certain species of fig trees. In Biliran, a lone buri palm, standing near the beach, was loaded with fruit and was regularly visited by crows and imperial pigeons. Merrill's fruit pigeon, *Leucotreron* (*Neoleucotreron*) *merrilli* McGregor, was collected in Laguna Province only when it was feeding on the small fruits of *Symplocos ahernii* Brand. By waiting beneath these trees we could see the pigeons as they moved about in feeding; at other times it was impossible to detect them among the leaves. In Polillo a parrot (*Tanygnathus freeri* McGregor) fed on the fruit of *Artocarpus camansi* Blanco and of *Dillenia philippinensis* Rolfe. In the same island *Penelopides subnigra* McGregor was often found feeding on the fruit of *Dysoxylum altissimum* Merrill and of a species of *Ficus*.

The pittas are short-tailed, plump birds with bright-colored plumage. Their well-developed legs enable them to hop about beneath the forest undergrowth and in thickets where they sometimes make considerable noise in scratching among dry leaves. Nevertheless all of the pittas are shy birds, and although gorgeously colored they are among the birds requiring the greatest skill and patience on the part of the collector.

The puñaladas, or blood-breasted pigeons (*Phlegœnas* vel *Gallicolumba*), are usually seen walking quietly along a forest trail or hastening across a small opening, but they are very nervous and take flight at the least suspicious noise or movement and are by no means easy to get sight of.

Several types of kingfishers inhabit the forest. They are all beautifully colored, but they seem to have been influenced by their habitat for they are usually silent and retiring. It does not seem possible that they are related to the noisy, impudent, and conspicuous species of the open country.

The most gorgeous Philippine bird is the Palawan peacock pheasant, *Polyplectron napolionis* Lesson, yet it is seldom seen. Mr. Worcester has told me that he never saw an individual of this species in the field and that all of the specimens obtained by him were purchased from men who had snared them.

The male of the Philippine trogon, *Pyrotrogon ardens* (Temminck), is perhaps the most beautiful—certainly it is the most brilliantly colored—Philippine bird of medium size; but as it sits on a branch 10 to 15 meters from the ground, motionless in the mottled light and shadow, it is far from being conspicuous.

Of very rare Philippine birds perhaps the frogmouths (*Batrachostomus*) will ever remain the rarest. They superficially resemble the nightjars, especially in their soft mottled plumage and small feet; but the outermost pair of rectrices is only half as long as the middle pair, and the wings are shorter than in the Caprimulgidæ. The most conspicuous feature of *Batrachostomus* is its bill, which is enormous and has a peculiar sigmoid curve to the cutting edge that gives these birds a very grotesque expression, especially when seen in full-faced view. Undoubtedly they hunt at night and rest in deep shade during the day; I have seen only a few specimens, and these were obtained by the merest chances.

Two curious species of the endemic genus *Sarcophanops*, one of which inhabits Mindanao and Basilan, the other, Samar, are the only Philippine members of the order Eurylæmiformes. Little is known about the habits of these birds. They are usually found in small parties perching quietly among the branches of forest trees, and they display more curiousity than fear in the presence of man. The conspicuous characters of these birds are the broad bill, the bristles about the mouth, the ring of bare skin around the eye, the wedge-shaped tail, and the peculiar colors. In *Sarcophanops steeri* the bill, the fleshy wattle about the eye, and the feet are light blue; the iris is blue or green, depending upon the angle of the light. The chin, throat, and wings are black, the secondaries with a band of yellow and white near the middle; the top of the head is dark purple, separated from the brown back by a white collar; the rump and the tail are bright chestnut. The breast and the sides are lilac in the male and white in the female. The length is about 175 millimeters.

One of the largest eagles known,[60] *Pithecophaga jefferyi* Grant, inhabits the forests of Luzon, Samar, and Mindanao. It is

[60] See Shufeldt, R. W., Philip. Journ. Sci. 15 (1919) 31.

known to eat monkeys.[61] In contrast to this ponderous eagle is the butterfly falcon, *Microhierax erythrogenys* (Vigors), which is no larger than a large sparrow.

LOCAL ABUNDANCE OF CERTAIN SPECIES OF BIRDS

A curious condition is found in some small islands, where one or more local species may be common over the entire area of the island, even if there be but little forest. Thus, *Dicruropsis cuyensis* (McGregor) is found all over Cuyo, and *Zosterops richmondi* McGregor fairly swarms on Cagayancillo; but neither genus is represented on the other island. *Hypsipetes fugensis* Grant and *Leptocoma henkei* (Meyer) are extremely abundant on both Fuga and Calayan. The latter species is found in Luzon also, but is not nearly so abundant as it is in the small northern islands. *Hyloterpe fallax* McGregor is one of the most abundant species on Calayan. *Terpsiphone periopthalmica* (Grant) is confined to Batan and is fairly abundant in forest over most of that island; the type specimen of this species came from Malabon, near Manila, but it must have been a straggler.

DISCONTINUOUS DISTRIBUTION OF SPECIES

This superabundance of one or a few species on a small island where other species occur in no more than their normal numbers seems to indicate that there are unusually favorable conditions on these small islands for some species. Another curious condition is the absence of a species from an island on which it is reasonable to expect it to occur. Thus, *Corvus philippinus* Bonaparte, a large, conspicuous bird, which is abundant in most islands, does not occur on Camiguin Island, north of Luzon, although it is found in Calayan, Fuga, and Luzon. *Pycnonotus goiavier* (Scopoli), one of the commonest and most universally distributed among Philippine species does not occur on any of the islands north of Luzon. Somewhat allied to this condition is the discontinuous, or interrupted, distribution of a species. *Centropus carpenteri* Mearns, of Batan Island, is very slightly if at all different from *C. mindorensis* (Steere), of Mindoro; yet no species like either of these is found on any of the intermediate islands or on any other island. *Camiguinia helenæ* (Steere) is abundant on Camiguin, north of Luzon, but is unknown south of there until northern Mindanao is reached. Specimens from these two localities are indistinguishable. *Chloropsis flavipennis* (Tweeddale) is one of the characteristic birds of Cebu and appears also in northern Mindanao. The first

[61] See Clemens, J., Condor 9 (1907) 92.

record of *C. flavipennis* for Mindanao was based on a specimen supposed to have been secured there by Platen, but the locality seemed impossible and for a long time the record was considered to be a mistake. However, the Bureau of Science has a specimen that was undoubtedly killed in Mindanao,[62] and it cannot be distinguished from Cebu specimens.

There are many other interesting genera of birds to be found in the primary lowland forest, but there is no need to mention more of them here. The endemic Philippine land birds are enumerated in Table 2, and most of these are forest-inhabiting species.

Where the altitude becomes too great for the dipterocarp, the molave, and the midmountain forest, there succeeds a mossy forest. In parts of Luzon and in western Mindoro there is a pine forest below the mossy forest.

PINE TYPE OF FOREST

The pine type is distinctly characterized by open stands of *Pinus insularis* Endlicher in north-central Luzon, of *Pinus merkusii* Junghuhn and De Vriese in Mindoro, and of both species in Zambales Province, Luzon. The pine type is found in a mountainous habitat at elevations of from 500 to 1,500 meters, with straggling specimens up to 2,700 meters. No other tree of importance is found in the pine type.

MOSSY TYPE OF FOREST

The summits and sides of many high and rough mountains are covered with a thick growth of more or less dwarfed trees, which are characteristically decorated with luxuriant growth of mosses, liverworts, foliaceous lichens, orchids, and ferns. The strong winds of these regions cause the stunted growth of the trees, while the high humidity favors the development of the fantastic epiphytic plant species that are characteristic of the mossy forest. Among the characteristic tree species of the mossy forest are *Podocarpus imbricatus* Blume, *Drimys piperita* Hooker f., *Dacrydium elatum* Wallich, and species of *Vaccinium, Rhododendron,* and *Quercus.* High-altitude species of *Eurya, Symplocos, Eugenia,* and many other genera that are also represented in the lowland forests are noteworthy.

To the casual observer the most obvious botanic feature of the mossy forest is the great quantity of epiphytic lichens, mosses, liverworts, ferns, orchids, and epiphytic flowering plants of certain families, especially species of the Melastomataceæ,

[62] Philip. Journ. Sci. § A 4 (1909) 74.

which grow in profusion on every shrub and tree so that their stems and branches are entirely hidden. The tree species are fewer than those of the lower and more level forests. The trees of the mossy forest are small; for the most part their trunks and branches are slender and are so twisted and distorted as to be useless for commercial lumber. Many of the individual trees are so covered with moss that the branches and the smaller trunks appear to be two or three times their actual diameters. The forest is so crowded with inclined and twisted trunks, which are hidden beneath a dense growth of ferns and herbaceous plants, that walking is difficult. On the steeper slopes progress is slow and laborious and in places is dangerous if not nearly impossible. All of this vegetation is almost continuously saturated with moisture.

On the higher ridges and the summits of many peaks the vegetation is much dwarfed, tree species being reduced to mere shrubs. Mount Pulog is an exception to this rule, for above the mossy forest its summit protrudes entirely free of shrubs and trees, the only vegetation here being a thick carpet of small grasses, sedges, and herbs.

In the ascent of Mount Pulog four main types of vegetation are noted, the first three of which are characteristic of the entire Benguet-Lepanto region, the fourth being apparently entirely confined to Mount Pulog. The steep slopes leading up from the river are covered almost entirely with grass, although scattered broad-leaved shrubs and small trees are found in the gullies and stream depressions; this grass-covered area extends to an altitude of about 1,200 m. The second formation encountered is an open forest belt in which the pine (*Pinus insularis* Endl.) is the characteristic tree, which extends upward to an altitude of about 2,200 m. The third formation, the mossy forest, extends from the upper limits of the pine region to an altitude varying from 2,500 m to 2,600 m. The fourth formation, the open, grass-covered summit, extends from the upper limits of the mossy forest to the top of the mountain. Mount Pulog is apparently the only peak in the entire region that has an area of grass land succeeding the mossy forest; all the other peaks are forested to the summit.[63]

Brown's description of the changes in vegetation on Mount Maquiling can be appropriately included at this point. In his summary Brown says:[64]

The vegetation on Mount Maquiling shows a gradation from a tall forest at the base of the mountain to a dwarfed mossy one at the summit.

Between elevations of about 100 and 600 meters there is a tall diptero-

[63] Merrill, E. D., and Merritt, M. L., Philip. Journ. Sci. § C 5 (1910) 294.

[64] Vegetation of Philippine Mountains. Bureau of Science, Manila (1919) 414.

carp forest, a type of Schimper's tropical rain forest, characteristic of the lowlands in the Philippines and in many other parts of the Indo-Malayan region. This forest consists of three stories of trees, each composed of different species. The first, or tallest, story is dominated by members of the family Dipterocarpaceæ. At middle elevations the forest consists of two stories composed of different tree species. At the top of the mountain there is only one story of trees. These trees are dwarfed and very peculiarly shaped and are thickly covered with mosses and mosslike plants. Mossy forests are frequently found on high mountains in the Philippines and elsewhere in the tropics.

The ground covering in the dipterocarp forest is composed largely of tree seedlings and, at higher elevations, of herbaceous plants.

The epiphytes in the dipterocarp forest are largely phanerogams and are confined chiefly to the largest branches of the tallest trees. At middle elevations epiphytes are more numerous and cryptogams are more conspicuous. Mosses and liverworts may form a thin covering over a considerable portion of the trunks of trees. The greatest development of epiphytes is at the top of the mountain in the mossy forest, where the lower branches and the trunks of the trees are thickly covered with mosses and mosslike plants, in which grow a number of larger plants, including phanerogams. On the smaller branches epiphytes are also numerous, but less so than on the trunks.

BIRDS OF THE HIGHLANDS

Highlands is used here as a loose term to designate the mountainous regions above 1,200 meters' altitude. The land birds so far mentioned are found in cleared areas, in second growth, in grasslands, and in lowland forest. There remains to be said something of the change in the avian fauna with change in elevation. In northern Luzon there is a large area having a general elevation of from 1,200 to 1,600 meters and many parts are much higher than this. The highest point in Luzon is believed to be the summit of Mount Pulog, which is 2,880 meters (9,480 feet) in altitude.[65] The flora of most of this region is characterized by open, parklike forests of *Pinus insularis;* except as scattered individuals this species does not grow below about 1,200 meters. Above 2,200 meters, especially on ridges and the summits of peaks, the pine gives way to a mossy forest.

Several of the other large islands present almost the same changes in vegetation with increase in altitude as those described for northern Luzon, but only one other island of this Archipelago, Mindoro, yields trees of the genus *Pinus.*

Before John Whitehead made his first trip into Benguet Province, nothing was known of the highland fauna. It is true that

[65] See Merrill, E. D., and Merritt, M. L., Philip. Journ. Sci. § C 5 (1910) 290.

two of the most remarkable highland species, *Pitta kochi* Brüggemann and *Leucotreron marchei* (Oustalet), had been described from specimens labeled "Manilla," but no one seems to have suspected that these were representatives of a distinct highland fauna.[66]

Whitehead's first highland collection[67] was made in the vicinity of Trinidad, which marks about the lower limit of the pine forest in that region.

After the Benguet trip Whitehead visited other parts of northern Luzon and collected specimens of nearly every species of bird that is known from these highlands. In Isabela Province he discovered *Zosterornis striatus* Grant and *Oriolus isabellæ* Grant.[68]

On his next trip, although he was very weak and scarcely able to eat or to walk because of dysentery, Whitehead pushed to the elevated region known as Mount Data where he rediscovered the two magnificent species *Pitta kochi* Brüggemann and *Leucotreron marchei* (Oustalet). On this trip he added ten new species to the known fauna of the Philippines, and some of them are characteristic of the highlands. Nearly all of the species discovered by Whitehead in the highlands have been collected since by Worcester, Mearns, or McGregor.

Scops whiteheadi Grant, *Pitta kochi* Brüggemann, and *Lusciniola seebohmi* Grant have not been collected since Whitehead's time. My own work in the vicinity of Baguio and in the mossy

[66] Many of the early specimens came from "Manilla," but few of them were collected in the vicinity of Manila; certainly not these two species, for no one has found either of them in the lowlands and no one ever will. How the types of these two rare species and no others came out of the mountains probably will never be known.

[67] See Grant, W. R. O., On the birds of the Philippine Islands. Part II. The highlands of north Luzon, 5,000 feet, Ibis VI 6 (1894) 501–522. Grant described nineteen new species in this paper, but some of the species included in Grant's paper were collected at lower elevations and near the coast, as can be determined by an examination of Whitehead's notes, Ibis VII 5 (1899). For example, under *Cinnyris jugularis* (vel *C. obscurior* Grant), Whitehead says: "We met with this species as high as 3,000 feet in Benguet." Under *Oriolus albiloris* he says: "The unique specimen obtained was shot in the Benguet mountains at an altitude of 2,000 feet."

It is unfortunate that Whitehead's notes were not published with Grant's reports on the collections. With regard to this Grant says: "We cannot help thinking, however, that the delay in publishing these valuable notes, which cannot fail to be of the greatest interest, is a mistake, as such information would greatly enhance the value of the papers published on his collections, which are at present, of necessity, somewhat dry reading, dealing, as they do, merely with the birds from a scientific point of view."

[68] Grant, W. R. O., Ibis VII 1 (1895) 106–117.

forest at Pauai, on Mount Pulog, and on Polis Mountain has yielded just one additional novelty, *Prionochilus anthonyi* McGregor.[69] The discovery of this remarkably distinct species indicates that there may be yet a few unknown species in this vast, elevated area in which no thorough collecting has been done.

The number of species to be found in the mossy forest in Luzon is small, and the number of species confined to it is very much smaller. Only twenty-two species were seen near Pauai (Haight's), which is a very favorable locality for birds. The following species appear to be confined to the mossy forest:

Leucotreron marchei (Oustalet). Mount Data and Polis Mountain; rare.
Pyrrhula leucogenys Grant. Common at Pauai and at other localities in the mossy forest.
Rhinomyias insignis Grant. Pauai and Mount Data; rare.
Pitta kochi Brüggemann. Known only from Mount Data.
Lusciniola seebohmi Grant. Known only from Mount Data.
Prionochilus anthonyi McGregor. Known only from Polis Mountain.

Some of these species may turn up at much lower altitudes. *Loxia luzoniensis* seems to be confined to the pine regions without regard to altitude. Nearly all of the other species so far recorded from the mossy forests of Luzon are known also from the broad-leafed forest below the pine belt, and many of them are abundant in the lowland forests, below 500 meters' altitude.

BIRDS OF THE HIGHLANDS OF NORTHERN LUZON

The following species are all that have been recorded in northern Luzon from above 1,200 meters' altitude.

The list is based on the lists of Whitehead's collections published by Grant, on Whitehead's field notes, and on my own published records. From Whitehead's notes it is clear that some of the species included by Grant as coming from the highlands were really collected in the lowlands. For example, *Oriolus albilorus* and *O. isabellæ* are common at less than 100 meters' altitude in suitable forest. Some of the other specimens reported by Grant as coming from "5,000 feet" were undoubtedly collected at much lower altitudes. My own experience in the Mountain Province as well as in other parts of Luzon has been of help in preparing this list.

Excalfactoria lineata (Scopoli). A characteristic lowland species that may be found within the lower limits of the highlands. Recorded by Whitehead from 1,200 meters.[70]

[69] Philip. Journ. Sci. § D 9 (1914) 531, pl. 1.

[70] The altitudes given by Whitehead in feet have been changed to meters; the odd quantities of less than 50 meters are of no consequence and are not recorded.

Gallus gallus (Linnæus). A lowland species; rare in the highlands; Whitehead found it at 2,100 meters in Lepanto.

Turnix ocellata (Scopoli). Found by Whitehead at 1,800 meters in Benguet, but certainly rare at such an altitude.

Phapitreron leucotis (Temminck). Common in the lowlands; recorded by Whitehead at 2,100 meters.

Leucotreron marchei (Oustalet). A high-mountain species probably rarely found below 2,000 meters.

Ptilocolpa carola (Bonaparte). Common at about 1,300 meters, but known also at sea level, from the vicinity of Manila.

Columba griseigularis (Walden and Layard). A forest species found from sea level to 2,300 meters.

Macropygia tenuirostris (Bonaparte). From sea level to about 2,800 meters.

Hypotænidia philippensis (Linnæus). From sea level to 1,500 meters at the base of Mount Data.

Limnobænus fuscus (Linnæus). From sea level to 1,500 meters at the base of Mount Data.

Gallinula chloropus (Linnæus). Common at sea level; on a small lake in Benguet at 1,200 meters.

Tachybaptus philippinensis (Bonnaterre). Common in the lowlands; one recorded from 1,500 meters at the base of Mount Data.

Gallinago megala Swinhoe. Abundant in the lowlands during migration; noted by Whitehead in a marsh at 1,200 meters.

Gallinago gallinago (Linnæus). Rarer than *G. megala;* Whitehead got one at 1,200 meters.

Butorides javanica (Horsfield). A lowland species extending up to about 1,200 meters at least.

Accipiter confusus (Hartert). From the lowlands up to 2,400 meters.

Lophotriorchis kieneri (Geoffroy St. Hilaire). A rare hawk of the lowlands; Whitehead killed one "on our journey to Lepanto." No altitude is given by him.

Spizaëtus philippensis Gurney. A forest hawk; Whitehead saw one on the seacoast and another at 1,200 meters in Benguet.

Spilornis holospilus (Vigors). The serpent eagle is a lowland species, but Whitehead records it from "the highlands of North Luzon" without giving the altitude.

Butastur indicus (Gmelin). A common migrant in many parts of the Philippine Islands. Whitehead says of it: "Common during the winter months in North Luzon."

Haliastur intermedius Gurney. Common in the lowlands. Whitehead says: "This Kite soon found our camp on Monte Data, and was almost a daily visitor."

Falco ernesti Sharpe. Rare; Whitehead collected "a fully adult male on the summit of Monte Data."

Falco severus Horsfield. Seen in the lowlands and at 1,200 meters in Benguet. Whitehead collected a male at over 2,100 meters in Lepanto.

Pseudoptynx philippensis Kaup. Whitehead found this species in Benguet and in Isabela, but gives no altitude. I obtained one at 1,200 meters in Benguet and have not seen it in the lowlands.

Otus longicornis (Grant). Known only from Benguet, at about 1,200 meters, and Mount Data, at about 2,100 meters.

Otus whiteheadi (Grant). Known only from Mount Data. Whitehead says that he heard it in Benguet.

Prioniturus montanus Grant. Very common in the highlands from 1,200 to about 2,900 meters. It is also found at considerably lower altitudes. In the coast forest it is replaced by *P. discurus* and *P. luconensis*.

Loriculus philippensis (P. L. S. Müller). From near sea level to about 1,200 meters.

Yungipicus validirostris (Blyth). From sea level to about 2,400 meters.

Batrachostomus microrhynchus Grant. From 1,200 to over 2,400 meters. This is the only species of frogmouth known from Luzon, and it may yet be found in the lowlands.

Eurystomus orientalis (Linnæus). Abundant from sea level up to 1,200 meters.

Alcedo bengalensis Gmelin. Abundant at sea level and fairly common at 1,200 meters.

Halcyon gularis (Kuhl). A characteristic species of the lowlands; extends to at least 1,200 meters in Benguet.

Hydrocorax hydrocorax (Linnæus). A forest bird of the lowlands, probably not found above 1,200 meters.

Penelopides manillæ (Boddaert). The range of this small hornbill seems to coincide with that of the last preceding species. Neither of them is a mountain bird.

Merops philippinus Linnæus. This species and *Merops americanus* (P. L. S. Müller) are common enough in the lowlands; Whitehead records *M. philippinus* from 1,500 meters in Benguet.

Caprimulgus manillensis Walden. This is a lowland species, but Whitehead found it at 1,200 meters in Benguet. Whitehead does not mention *C. griseatus* as being found so high as this. He found *Lyncornis* at 900 meters although Grant has included both of these genera in the Benguet list. While they may occur at the lower limits of our highlands, they are much commoner in the lowlands.

Hemiprocne major (Hartert). From the sea coast up to about 1,200 meters.

Collocalia whiteheadi Grant. Common at from 1,200 to 2,800 meters, but also extending into the lowlands. The type came from Mount Data.

Collocalia fuciphaga (Thunberg). A lowland species, found also at about 1,200 meters in Benguet and at 2,100 meters on Mount Data.

Collocalia isonota (Oberholser). Found in the lowlands and from 1,200 to 2,300 meters in the highlands.

Hierococcyx sparverioides (Vigors). This was collected by us at 1,200 meters, but is probably more of a lowland species.

Cacomantis merulinus (Scopoli). Very common in the lowlands and found up to at least 1,200 meters.

Lepidogrammus cumingi (Fraser). This endemic species is usually found in the lowlands, but Whitehead records it at 2,100 meters.

Chrysocolaptes hæmatribon (Wagler). This woodpecker is usually common in the lowland forest, but has been found in the highlands at from 1,200 to about 2,800 meters.

Thriponax confusus Stresemann. The range of this large woodpecker coincides with that of the next preceding species.

Pitta kochi Brüggemann. This pitta has been found only on Mount Data.

Hirundo striolata (Boie). Whitehead records this species from 1,500 meters in Benguet. Mosque swallows are abundant at low altitudes during migration, and some of them are resident. Perhaps the breeding birds belong to a distinct race or subspecies.

Hemichelidon griseosticta Swinhoe. Probably a winter migrant only. Common in the lowlands and found up to at least 1,200 meters.

Muscicapula westermanni Sharpe. This appears to be a highland species; it is abundant at from 1,200 to 2,400 meters.

Muscicapula luzoniensis Grant. From 1,200 to 2,800 meters; Whitehead found it commoner at higher altitudes than he did in Benguet.

Rhipidura cyaniceps (Cassin). This is the Luzon representative of the forest fan-tailed flycatchers. It is common in the lowlands and at various altitudes up to 2,400 meters in the highlands.

Rhinomyias insignis Grant. Whitehead collected this species on Mount Data at 2,400 meters, and I found it near Pauai at about the same altitude. It is probably confined to the mossy forest.

Culicicapa helianthea (Wallace). A common highland species, from about 1,200 to over 2,800 meters. Also found in the lowlands.

Cryptolopha nigrorum Moseley. Found at all elevations in the highlands; it appears to be commoner at the higher elevations.

Eumyias nigrimentalis (Grant). Abundant in the highlands at all altitudes; Whitehead records it from as low as 900 meters.

Artamides striatus (Boddaert). I consider this to be a lowland species, but we found it at about 1,200 meters; Whitehead met with it at 2,100 meters.

Pericrocotus novus McGregor. Found at about 1,200 meters in Benguet and at about 2,400 meters on Polis Pass. This species probably occurs at all altitudes where there is suitable forest.

Pericrocotus cinereus Lafresneye. This is a migratory species that is at times abundant in the lowlands; it has been found up to about 1,200 meters.

Iole gularis (Pucheran). All species of *Iole* are characteristic of the lowlands, but *Iole gularis* is also abundant at about 1,200 meters in Benguet and occurs on Mount Pulog at about 2,400 meters.

Pseudotharrhaleus caudatus Grant. Very little is known about this shy bird; we got three specimens at about 1,200 meters in Benguet, but Whitehead found it only on Mount Data where he collected three specimens. It must be considered an exclusively highland genus until it is discovered in the lowlands.

Zosterornis whiteheadi Grant. This species is abundant at all elevations above about 4,000 feet. It reaches the lowlands in northern Luzon.

Brachypteryx poliogyna Grant. This appears to be an exclusively highland species and is perhaps most abundant at from 1,800 to 2,400 meters' altitude.

Planesticus thomassoni (Seebohm). This black thrush is characteristic of the Luzon highlands above about 1,200 meters.

Turdus chrysolaus Temminck. This Asiatic thrush occurs as a migrant in the Luzon highlands.

Turdus obscurus Gmelin. A migrant, like the last preceding.

Oreocincla varia (Pallas). A migrant found by Whitehead at between 1,800 and 2,400 meters.

Petrophila manillensis (J. R. Forster). Common from the lowlands to about 1,200 meters.

Chaimarrornis bicolor Grant. A characteristic highland species at from 1,200 to 1,800 meters; it is not known from the lowlands.

Calliope calliope (Pallas). This beautiful species is found in the lowlands during the winter, and Whitehead says that it occurs up to the summits of the highest mountains.

Locustella lanceolata (Temminck). This is probably only a winter migrant; we collected a few specimens at about 1,200 meters in Benguet.

Cisticola cisticola (Temminck). At about 1,200 meters in Benguet.

Cisticola exilis (Vigors and Horsfield). This was found at about 1,200 meters. Both species of *Cisticola* are commoner in the lowlands.

Megalurus palustris Horsfield. At about 1,200 meters in Benguet.

Megalurus tweeddalei McGregor. Whitehead records this species as occurring at 1,500 meters. The two species of *Megalurus* are much commoner in the lowlands.

Acanthopneuste borealis (Blasius). This is an abundant migrant throughout the lowlands and reaches at least the lower altitudes in the highlands.

Tribura seebohmi (Grant). The unique specimen was taken by Whitehead at 1,800 meters in Lepanto.

Horornis canturiens (Swinhoe). A winter visitor up to 1,500 meters.

Horornis seebohmi (Grant). Fairly common in the highlands at from 1,200 to 2,400 meters.

Phyllergates philippinus Hartert. Occurs at from 1,200 to 1,800 meters.

Artamus leucorynchus (Linnæus). Very abundant in the lowlands and up to about 1,200 meters.

Cephalophoneus validirostris (Grant). This species seems to occur only in the highlands at from 1,200 to 2,400 meters.

Cephalophoneus nasutus (Scopoli). This species occurs in the lowlands and extends into the highlands up to about 1,800 meters.

Hyloterpe albiventris Grant. This is the characteristic thickhead of the highlands up to about 2,400 meters' altitude, but Whitehead records it as occurring at 150 meters in Abra; we found it at about the same altitude in northern Luzon. It is, however, the highland species of *Hyloterpe* and is generally replaced by *H. philippinensis* in the lowland forests.

Pardaliparus elegans (Lesson). Common in forests at all altitudes, from sea level to the forests on Mounts Pulog and Data.

Callisitta mesoleuca (Grant). From 1,200 to 2,400 meters. At what altitude this species is replaced by the lowland species, *C. œnochlamys*, is not known.

Zosterops meyeni Bonaparte. This species seems to be unrestricted by altitude for it is found in the lowlands and on Mount Data.

Zosterops whiteheadi (Hartert). Described from Benguet specimens. Whitehead got *Z. aureiloris* Grant at 300 meters in Abra. The vertical range of the various silvereyes that have been credited to Luzon is doubtful. Possibly none of them is exclusively highland.

Dicæum luzoniense Grant. Common at 1,200 meters in Benguet; found by Whitehead on the summit of Mount Data. It is probably a highland species.

Prionochilus anthonyi McGregor. Known only from Polis Mountain.

Dicæum pygmæum (Kittlitz). A common species in many parts of the Islands and recorded by Whitehead as being found up to 1,800 meters.

Dicæum obscurum Grant. Known only from Benguet at 1,200 to 1,500 meters.

Eudrepanis jefferyi Grant. Whitehead gives the range of this species as from 1,500 to 2,300 meters; I collected it at about 1,200 meters. The other Philippine species of *Eudrepanis* occur in the lowlands of other islands; no thorough collecting has been done in Luzon, and *E. jefferyi* may be eventually taken in lowland forest.

Leptocoma henkei (Meyer). Commoner in the lowlands than in the mountains; Whitehead found it at about 1,500 meters.

Motacilla melanope Pallas. A lowland species found up to about 1,200 meters.

Budytes leucostriatus Homeyer. Common near the coast during migration; also recorded in Benguet at about 1,200 meters.

Anthus hodgsoni Richmond. Occurs during migration up to 1,800 meters.

Anthus rufulus Vieillot. Abundant in the lowlands and also recorded from the lower mountainous parts of northern Luzon.

Anthus gustavi Swinhoe. A migratory species that occurs from sea level up to about 1,200 meters.

Mirafra philippinensis Ramsay. Fairly common at low altitudes and occurs up to 1,200 meters.

Loxia luzoniensis Grant. Probably occurs in northern Luzon wherever there are pine trees; it is not known to occur below about 1,200 meters.

Munia jagori Martens. Abundant at low altitudes and noted at 1,200 meters.

Emberiza pusilla Pallas. A rare migrant, recorded from Benguet at 1,200 meters.

Emberiza sulphurata Temminck and Schlegel. A migrant; commoner than *E. pusilla* and found from the coast up to 1,800 meters' altitude.

Munia jagori Martens. Abundant at low altitudes and noted at 1,200 meters in Benguet.

Munia cabanisi Sharpe. Much rarer than *M. jagori* and with about the same vertical range in Luzon.

Uroloncha everetti (Tweeddale). Rare; its vertical range is about the same as that of the two species of *Munia* mentioned.

Reichenowia brunneiventris (Grant). Whitehead has recorded this species as being found at 600 meters in Benguet and at 2,300 meters on Mount Data.

Sarcops calvus (Linnæus). This starling is characteristic of the lowlands and is found up to about 1,200 meters.

Corvus philippinus Bonaparte. Common in nearly all of the Islands and occurs in Benguet up to about 1,200 meters.

BIRDS OF THE HIGHLANDS OF OTHER ISLANDS

Mindoro, Negros, and Mindanao, in addition to Luzon, have yielded highland species. Several collectors have visited Mindoro, but only two seem to have collected at what can be called highland stations. Whitehead succeeded in reaching an altitude of "nearly 6,000 feet" where he secured only two species that

were new to science; namely, *Planesticus mindorensis* (Grant) and *Zonophaps mindorensis* (Whitehead).[71]

In 1906 Mearns headed an expedition that pushed to the summit of Mount Halcon.[72] The results in birds were disappointing, for this party, like Whitehead's, encountered incessant rain at high altitudes. Mearns has described the following from Mindoro: *Cyornis mindorensis,* from 150 meters' altitude; *Zosterops halconensis,* from 1,400 meters' altitude; and *Dicrurus balicassius mindorensis,* from the lowlands. Probably none of these is an exclusively highland species.

In Negros Whitehead collected only two new highland species; namely, *Planesticus nigrorum* (Grant) and *Brachypteryx brunneiceps* Grant.[73]

Mindanao contains lofty mountains on a scale similar to Luzon, and many striking species have been brought to light by Goodfellow, Waterstradt, and Mearns. Further exploration, especially of the higher mountains, will doubtless result in additions to the known bird fauna of Mindanao. Most of the following species are confined to the highlands of Mindanao:

Trichoglossus johnstoniæ Hartert. Mount Apo.
Prioniturus waterstradti Rothschild. Mount Apo, at 900 to 2,500 meters.
Prioniturus malindangensis Mearns. Mount Lebo, a spur of Mount Malindang, at 1,500 meters.
Chrysocolaptes montanus Grant. A partially alpine form, also found on the coast.
Chrysocolaptes malindangensis Mearns. Mount Malindang, at 1,800 meters.
Muscicapula montigena Mearns. Mount Apo, at 1,800 meters.
Rhipidura nigrocinnamomea Hartert. Mount Apo.
Rhipidura hutchinsoni Mearns. Mount Malindang, at 1,200 to 2,700 meters.
Rhinomyias goodfellowi Grant. Mount Apo.
Rhinomyias mindanensis Mearns. Mindanao (in general?).
Cryptolopha mindanensis Hartert. Mount Apo.
Cryptolopha malindangensis Mearns. Mount Malindang, at 2,700 meters.
Eumyias nigriloris (Hartert). Mount Apo.
Malindangia mcgregori Mearns. Mount Malindang, at 1,200 to 2,700 meters.
Pericrocotus johnstoniæ Grant. Probably a lowland species.
Pseudotharrhaleus unicolor Hartert. Mount Apo.
Pseudotharrhaleus malindangensis Mearns. Mount Malindang, at 2,700 meters.
Macronous montanus Mearns. Pantar, at 610 meters; and Mount Apo, at 1,220 meters.

[71] Grant, W. R. O., Ibis VII 2 (1896) 457–477.
[72] See Merrill, E. D., Philip. Journ. Sci. § A 2 (1907) 179.
[73] Grant, W. R. O., Ibis VII 2 (1896) 525–565.

Leonardina woodi (Mearns). Mount Apo, at 1,220 meters.
Brachypteryx mindanensis Mearns. Mount Apo, at 1,220 meters.
Brachypteryx malindangensis Mearns. Mount Malindang, at 2,700 meters.
Planesticus kelleri (Mearns). Mount Apo, at 1,800 meters.
Planesticus malindangensis (Mearns). Mount Malindang, at 1,500 to 2,700 meters.
Geokichla mindanensis Mearns. Mount Apo, at 2,000 meters.
Phyllergates heterolæmus Mearns. At 2,000 meters.
Hyloterpe apoensis Mearns. Mount Apo, at 1,800 meters.
Pardaliparus mindanensis Mearns. Mount Apo, at 1,800 meters.
Zosterops vulcani Hartert. Mount Apo.
Zosterops malindangensis Mearns. Mount Malindang, at 1,800 meters.
Hypocryptadius cinnamomeus Hartert. Mount Apo.
Dicæum apo Hartert. Mount Apo.
Dicæum davao Mearns. Seems to be a lowland species.
Dicæum nigrilore Hartert. A mountain species?
Æthopyga boltoni Mearns. Mount Apo, at 1,900 meters.
Pyrrhula steerei Mearns. Mount Apo, at 1,700 meters.
Lamprocorax todayensis Mearns. Mount Apo, at 1,200 meters.
Goodfellowia miranda Hartert. Mount Apo.

In the preceding consideration of the forest species of Philippine birds I have tried to indicate that many of the lowland forest genera persist to considerable elevations, in some cases without change of species. On the other hand it has been noticed that in Luzon, above about 1,200 meters' altitude, the lowland species in several genera are replaced by other, more or less distinct, species; for example, in *Prioniturus, Callisitta, Dicæum, Leucotreron* (subgenus *Neoleucotreron*), *Pitta, Otus, Lanius, Hyloterpe,* and *Rhinomyias.*

The highlands also yield genera that are unrepresented in the lowlands. Among these are *Pseudotharrhaleus, Brachypteryx, Planesticus, Chaimarrornis, Tribura, Loxia, Malindangia, Goodfellowia, Hypocryptadius, Leonardina,* and *Pyrrhula.* Some of these genera are found only in the Philippine Islands, while the others are represented in neighboring and distant parts of the world.

LOCAL DISTRIBUTION OF ENDEMIC PHILIPPINE BIRDS

If we consider the distribution of the endemic species of Philippine birds we find that certain species occur in nearly all the islands of the Archipelago. *Corvus philippinus, Pycnonotus goiavier,* and *Oriolus acrorhynchus* are example of these, and such species are usually abundant. Other species are the sole members of their respective genera and are confined to single islands; such are *Dasycrotapha speciosa, Malindangia mcgregori,* and *Goodfellowia miranda.*

Most of the endemic species are confined to single islands or to groups of islands, while the genera to which they belong are represented in other islands by other endemic species.

Walden [74] long ago remarked that—

> As might be anticipated from analogy with other isolated areas, some of the Philippine Islands, although only separated by narrow seas, possess species peculiar to themselves. Although well defined, these are strictly representative forms.

Steere has expressed this phase of distribution in the following words:

> The law of distribution of non-migratory land-birds of the Philippines may be stated as follows:—*Every genus is represented by only a single species in one place.* Or, in more general terms, as follows:—*No two species structurally adapted to the same conditions will occupy the same area.* [Italics are given as in the original.] [75]

The first statement of Steere's law seems rather unfortunate, for "place" is a word of too general meaning. It is hard to understand why he did not use "island," which seems from the context to be what he meant. If the law were restated with more precise words it would read: "No genus is represented by more than one species in any island." As a matter of fact there are many genera of which this is not true. This was recognized by Steere, and he makes the following statement:

> In 17 genera and 74 species each genus is represented in the islands by several species, two or more of which may be found inhabiting the same island; but the species thus found together, with the same generic name, differ greatly in size, colouring, or other characteristics, and belong to different natural sections or subgenera.
>
> Authors have already attempted in several cases to raise the natural sections of these genera [Steere's list D] to generic rank.

By "other characteristics" Steere seems to have intended food, kind of country inhabited, and whether a species is social or solitary. Although these characteristics, as well as size and coloring, may be made use of in generic descriptions they are not considered to be valid generic characters.

Steere admits that the two species of Philippine bee eaters "probably exist together on every island of the group." He then says that they differ in habits and food; therefore they belong to different subgenera; hence, they are not an exception to

[74] Trans. Zool. Soc. London 9 [2] (1875) 131.

[75] Ibis VI 6 (1894) 419. In the Auk 11 (1894) 239, Steere gave his law in a slightly different form, as follows: "*The genus is represented by but a single species in a place.*" and "*No two species near enough alike structurally to be adapted to the same conditions will occupy the same area.*"

Steere's law. These two species of *Merops* do differ in colors, but they are certainly of nearly the same size, and other observers do not agree with Steere's statement that they differ in habits. If they do not belong to one subgenus then genera and subgenera mean nothing. Steere gives several other genera that seem to conflict with his law, and his explanations for these are similar to his explanation for *Merops*.

There are other cases of two species of one genus occurring in one place that Steere did not know of. It would be interesting to know the generic characters on which Steere would separate *Leptocoma sperata* from *L. henkei* and *Oriolus albiloris* from *O. isabellæ*. The two species of *Leptocoma* can be found feeding in the same tree; and the two species of forest orioles, which were unknown to Steere, inhabit exactly the same kind of woods; in fact my first specimens were killed in one grove of trees in Bataan Province.

The second part of Steere's law, or the law "in more general terms," seems to be meaningless, for if two species, of the same genus or of different genera, occupy the same area, this fact proves that they are adapted to the same conditions.

It is not my intention to say any more about Steere's law, for the evidence has been fully discussed by Worcester, but the distribution of some of the species that do conform to Steere's law is interesting. The distribution of the three species of the endemic genus *Hydrocorax* illustrates what Steere intended to express in his law. *Hydrocorax hydrocorax* inhabits Luzon and Marinduque; the bill and casque are entirely bright red, the upper outline of the casque is straight, and the anterior end overhangs the culmen. *Hydrocorax mindanensis* inhabits Mindanao and Basilan; the casque and the basal half of the bill are bright red; the terminal half of the bill is whitish; the outline of the bill is similar to that of *H. hydrocorax*. *Hydrocorax semigaleatus* inhabits Samar, Leyte, Biliran, Bohol, and Panaon; the bill is red and whitish as in *H. mindanensis;* the casque is contracted in front, its anterior end sinking to the culmen and not forming an anterior overhanging projection. The last species is the type of *Platycorax* Oberholser.

The distribution of the endemic species of a nonendemic genus is illustrated by *Loriculus*.

Loriculus philippensis (P. L. S. Müller) is found in Luzon and in some of the small islands near it.

Loriculus mindorensis Steere is confined to Mindoro.

Loriculus bournsi McGregor inhabits Romblon, Tablas, and Sibuyan.

Loriculus regulus Souancé is found in the central islands Negros, Guimaras, Panay, Masbate, and Ticao.
Loriculus chrysonotus Sclater is confined to Cebu.
Loriculus siquijorensis Steere is confined to Siquijor.
Loriculus worcesteri Steere inhabits Samar, Leyte, and Bohol.
Loriculus apicalis Souancé is known from Mindanao, Dinagat, and Bazol.
Loriculus dohertyi Hartert is confined to Basilan.
Loriculus bonapartei Souancé inhabits Sulu, Tawitawi, and Bongao.

It is important to note that the genus *Loriculus* has no representative in Palawan, on the west, and in the Babuyanes and the Batanes, north of Luzon.

On the basis of evidence afforded by the distribution of endemic species, such as those just given, Steere [76] divided the Islands into subprovinces, and most of these divisions have survived the test of more detailed work based upon much more material.

The sub-provinces proposed are—first, the Northern Philippines, consisting of Luzon and Marinduque, and a number of other small islands about Luzon; second, Mindoro; third, the Central Philippines, made up of the islands of Panay, Negros, Guimaras, Zebu, Bohol, and Masbate; fourth, the Eastern Philippines, comprising the islands of Samar and Leyte; fifth, the Southern Philippines, embracing the great island of Mindanao, with Basilau [sic], and perhaps Sulu; and sixth, the Western Philippines, consisting of the islands of Paragua or Palawan, and Balabac.

In the main Steere's subprovinces are the same as the divisions now recognized. It seems rather curious that Steere made no use of previous records, even the results of his own first trip to the Islands seemingly being ignored by him. He says:[77]

In this study only collections made by the members of the [Steere] party have been used. * * * About five thousand specimens of birds were collected by the party, these belonging to about four hundred species. They were collected on seventeen distinct islands of the archipelago, which were chosen, from their size and location, as representative of the whole.

These collections, while not comprising examples of all the species known from the islands, are so nearly complete that any just conclusions drawn from their study must be accepted as truths which further exploration will only strengthen.

Everett [78] has published an excellent paper in which is presented the evidence for considering that Palawan and Balabac are more strongly Bornean than Philippine. Everett [79] has also

[76] Nature 39 (1888) 37, 38. This article is dated "Manila July 2, 1888."
[77] Ibis VI 6 (1894) 412. The article in the Auk differs slightly from this.
[78] Proc. Zool. Soc. London (1889) 220–228.
[79] Ibis VII 1 (1895) 21–39.

shown that Balabac is closely related to Palawan in regard to its birds.

Worcester [80] has published a very detailed review of Steere's work, taking advantage of much information in regard to distribution that was not available to Steere, notably the results of the Menage expedition and of Whitehead's numerous collections from the highlands.

Since Worcester and Burns [81] published their list a great deal of detailed work has been done on the distribution of the lowland species. Most of this has been published by Grant, W. E. Clarke, Worcester, Mearns, and McGregor.

In 1906 Worcester [82] republished his conclusions as to the divisions of the Islands that can be recognized, these conclusions being somewhat modified and extended by the work on distribution of Philippine birds that had been done since 1900.

It would be difficult to state the matter in clearer or more concise form than Worcester has done; and I shall quote from him in full, adding a few remarks of my own in square brackets. Worcester considers that the Philippine Islands may be divided into zoölogically distinct groups as follows:

(1) The Palawan group, consisting of Palawan and the small islands adjacent to it, Balabac, Cagayan Sulu, and the Cuyos and Calamianes Islands. The birds of this group show a very strong Bornean element. The line of demarcation between the Philippines, zoölogically speaking, and the Palawan Islands passes between Sibutu and the coast of Borneo and extends thence northward through the Sulu Sea east of the Cuyos group and through Mindoro Strait. [I do not include Cagayan Sulu in the Palawan group. The identification of specimens of *Pycnonotus plumosus* Blyth from Cagayan Sulu [83] adds to the previously existing evidence of the Bornean affinity of this island.]

(2) The central Philippines, comprising the Islands of Negros, Panay, [Bantayan,] [84] Guimaras, Masbate, and Ticao. They form a well-defined natural group, although in the case of Masbate and Ticao there are indications of immigration from Luzon. [Marilison and Batbatan, off the coast of Antique Province, Panay, have yielded no species that would indicate the faunal relationships of these small islands.] [85]

(3) Mindoro and some of the islands immediately adjacent to it, including Semerara and doubtless also Ylin. [A few birds have been recorded

[80] Proc. U. S. Nat. Mus. 20 (1898) 567–617.

[81] Op. cit. 551–564.

[82] In McGregor, R. C., and Worcester, D. C., A Hand-list of Birds of the Philippine Islands. Bureau of Government Laboratories, Manila 36 (1906) 5.

[83] McGregor, R. C., Philip. Journ. Sci. § D 11 (1916) 274.

[84] See McGregor, R. C., Philip. Journ. Sci. § A 2 (1907) 310.

[85] Bureau of Science collections of 1918; results unpublished.

from Caluya, from Sibay, and from Libagao;[86] all of them are common lowland species of wide distribution in the Philippines.]

(4) Luzon, Catanduanes, Marinduque, and Lubang. [Polillo belongs with this group, although it has three endemic species; its plants show some peculiar features.]

(5) Samar, Leyte, [Biliran,] and Bohol. * * * [The last collection made in Bohol included many species not previously known from that island; these fully confirm the belief that Samar, Leyte, and Bohol form a distinct group.[87] A small collection made by me in Biliran[88] shows that this island is merely a fragment of Leyte; these two islands are so near each other that no other result could have been expected.]

(6) Mindanao and the islands immediately adjacent to it form a group by themselves.

(7) Basilan must be separated from Mindanao on account of the fact that it has a number of representative forms of species characteristic of Mindanao. [*Orthotomus mearnsi* and *Loriculus dohertyi*, of Basilan, described since Worcester wrote the above, furnish further evidence of the difference between Basilan and Mindanao.]

(8) Bongao, Tawi Tawi, Lapoc, and Sulu form a well-marked natural group, to which Sibutu must probably be added.

(9) Tablas, Romblon, and Sibuyan show no evidence of having been connected with any of the neighboring larger islands. They have a number of peculiar species of birds, and Tablas and Romblon should probably be classed together. [Banton shows a slight relationship to Romblon. Cresta de Gallo, south of Sibuyan, is little more than a sand bar.]

(10) Cebu cannot be regarded as one of the central Philippine group but must be classed by itself.

(11) The Batanes Islands [= the Babuyanes] have a strong Formosan element among their birds. It remains to be seen whether the Babuyanes Islands [= the Batanes] must be grouped with them or must be considered as detached fragments of northern Luzon. [This paragraph is badly mixed. At the time that it was written we had a small collection from Fuga and a large collection from Calayan, both in the Babuyanes, but nothing was known of the birds of the Batanes. Since then we have secured collections from Camiguin, in the Babuyanes, and from Batan, in the Batanes; we also have a few, mostly unimportant, specimens from Dalupiri, Babuyan Claro, Y'Ami, and Sabtan. Although Camiguin, Calayan, and Batan, and perhaps some of the other islands of these two groups, show differences from each other, they all differ so much from Luzon that they form a group quite as distinct as some of the others considered above.]

(12) Siquijor, Cagayancillo, and Cresta de Gallo are islands of recent origin and their bird faunæ have been derived from neighboring islands. [Siquijor has three endemic species and lacks some of the central-island species, but it would be grouped with the central islands if with any. The fauna of Cagayancillo is more puzzling. *Cinnyris aurora*, a characteristic Palawan species, is as abundant there as it is on Cuyo; but *Dicruropsis*, which is common on Cuyo, is not found on Cagayancillo. *Zosterops richmondi*, endemic to the latter island, represents a genus that is unknown

[86] McGregor, R. C., Philip. Journ. Sci. 1 (1906) 698.

[87] See McGregor, R. C., Philip. Journ. Sci. § A 2 (1907) 315–333.

[88] Bureau of Science collection; results unpublished.

in the Palawan group; *Centropus viridis*, also found on Cagayancillo, is strictly non-Palawan. We found only eleven species of birds on Cresta de Gallo and none of them, except *Zosterops nigrorum*, has a restricted range in the Philippines.]

The total number of species of birds known from the Philippine Islands is 760, distributed in 292 genera; 477 species and 26 genera are endemic. These numbers include the shore and water birds, most of which are nonendemic both as to genera and species.

If the land birds alone be considered the numbers are approximately as follows:

Genera	209
Species	639
Endemic genera	26
Endemic species	469
Generic endemism (per cent)	12+
Specific endemism (per cent)	73+

These numbers are given for what they are worth; to be of real interest they should be compared with similar numbers for Borneo, Celebes, Papua, etc., but such numbers are not at hand.

The endemic species of Philippine land birds and their distribution by groups of islands are given in Table 2. The numbers in the box heads correspond with the numbers on the map, Plate 1, and with the paragraphs on pages 415 and 416.

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands.*

[An asterisk indicates an endemic genus.]

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
PHASIANIDÆ.											
Polyplectron napoleonis Less	×										
TURNICIDÆ.											
Turnix fasciata (Temm.)	×	×	×	×					×	×	
ocellata (Scop.)				×							
whiteheadi Grant				×							
worcesteri McG				×							
suluensis Mearns								×			
celestinoi McG					×						

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
TRERONIDÆ.											
Sphenocercus australis McG											×
Osmotreron axillaris (Bp.)		×	×	×	×	×	×		×	×	
everetti Roths								×			
Phapitreron amethystina Bp.*				×	×	×					
cinereiceps B. and W								×			
brunneiceps B. and W							×				
frontalis B. and W										×	
maculipectus B. and W		×									
leucotis (Temm.)			×	×							
occipitalis Salvad							×				
nigrorum Sharpe		×							×	×	
albifrons McG					×						
samarensis Mearns					×						
brevirostris Tweed						×		×			
Leucotreron occipitalis (Bp.)		×	×	×	×	×	×		×	×	
leclancheri (Bp.)	×	×	×	×	×				×	×	×
marchei (Oust.)				×							
merrilli McG				×							
Muscadivores nuchalis (Cabanis)			×	×		×					×
chalybura (Bp.)		×	×	×	×	×	×		×	×	
palawanensis (Blas.)	×										
langhornei (Mearns)						×					
Ptilocolpa carola (Bp.)*			×	×					×		
nigrorum Whitehead		×									
mindanensis Grant						×					
Zonophaps poliocephala (Hartl.)		×	×	×	×	×	×	×	×	×	
mindorensis (Whitehead)			×								
COLUMBIDÆ.											
Macropygia tenuirostris Bp	×	×	×	×	×	×	×	×	×		
phæa McG											×
CLARAVIIDÆ.											
Gallicolumba luzonica (Scop.)				×							
criniger (Jacq. and Puch.)					×	×	×				
keayi (Clarke)		×									
menage (B. and W.)								×			
platenæ (Blas.)			×								
FALCONIDÆ.											
Accipiter confusus Hartert		×	×	×	×	×				×	
Spizaëtus philippensis Gurney	×	×	×	×			×				
Pithecophaga jefferyi Grant*				×	×	×					

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
FALCONIDÆ—Continued.											
Spilornis holospilus (Vigors)			×	×	×	×	×	×		×	
panayensis Steere		×							×		
Baza magnirostris Gray				×		×					
leucopais Sharpe	×				×				×		
Microhierax erythrogenys (Vigors)			×	×	×						
meridionalis Grant					×	×				×	
STRIGIDÆ.											
Pseudoptynx philippensis Kaup*				×							
gurneyi Tweedd						×					
mindanensis Grant						×					
Otus megalotis (Gray)				×							
everetti (Tweedd.)	×				×	×	×				
fuliginosus (Sharpe)	×										
sibutuensis (Sharpe)								×			
longicornis (Grant)				×							
mindorensis (Whitehead)			×								
whiteheadi (Grant)				×							
cuyensis McG	×										
steerei Mearns								×			
calayensis McG											×
romblonis McG									×		
boholensis McG					×						
Ninox philippensis Bp		×		×	×						
everetti Sharpe								×			
spilocephala Tweedd						×	×				
spilonota B. and W			×						×	×	
reyi Oust								×			
mindorensis Grant			×								
plateni Blas			×								
Strix whiteheadi (Sharpe)	×										
LORIIDÆ.											
Trichoglossus johnstoniæ Hartert						×					
CACATUIDÆ.											
Cacatua hæmaturopygia (P. L. S. Müll.)	×	×	×	×	×	×	×	×	×	×	
PSITTACIDÆ.											
Prioniturus verticalis Sharpe								×			
montanus Grant				×							
discurus (Vieill.)		×		×	×	×	×	×	×	×	

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
PSITTACIDÆ—Continued.											
Prioniturus waterstradti Roths						×					
malindangensis Mearns						×					
mindorensis Steere			×								
cyaneiceps Sharpe	×										
luconensis Steere				×							
Tanygnathus lucionensis (Linn.)	×	×	×	×	×	×	×	×	×	×	
everetti Tweedd		×		×		×					
freeri McG				×							
burbidgei Sharpe								×			
Bolbopsittacus lunulatus (Scop.)*				×							
intermedius Salvad					×						
mindanensis Steere						×					
Loriculus chrysonotus Scl										×	
regulus Souancé		×									
bournsi McG									×		
philippensis (P. L. S. Müll.)				×							
mindorensis Steere			×								
siquijorensis Steere		×									
apicalis Souancé						×					
dohertyi Hartert							×				
worcesteri Steere					×						
bonapartei Souancé								×			
PODARGIDÆ.											
Batrachostomus septimus Tweedd						×	×				
microrhynchus Grant				×							
menagei B. and W		×									
ALCEDINIDÆ.											
Pelargopsis gouldi Sharpe	×		×	×							
gigantea Walden		×			×	×	×	×	×	×	
smithi (Mearns)		×									
Ceyx cyanopectus Lafres		×	×	×					×		
argentata Tweedd						×	×				
flumenicola Steere					×						
nigrirostris B. and W		×								×	
melanura Kaup				×							
mindanensis Steere						×	×				
samarensis Steere					×						
bournsi Steere		×				×	×	×	×	×	
goodfellowi Grant						×					

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
ALCEDINIDÆ—Continued.											
Halcyon ochrothorectis (Oberh.)	×	×	×	×		×			×		×
gularis (Kuhl)		×	×	×	×	×	×		×	×	
winchelli Sharpe		×			×	×	×	×	×	×	
hombroni (Bp.)						×					
lindsayi (Vigors)				×							
moseleyi (Steere)		×									
BUCEROTIDÆ.											
Hydrocorax hydrocorax (Linn.)*				×							
mindanensis (Tweedd.)						×	×				
semigaleatus (Tweedd.)					×						
Anthracoceros montani (Oust.)								×			
Gymnolæmus lemprieri (Sharpe)*	×										
Penelopides panini (Bodd.)*		×									
manillæ (Bodd.)				×							
talisi Finsch[a]				×							
subnigra McG.				×							
mindorensis Steere			×								
affinis Tweedd.						×					
basilanica Steere							×				
samarensis Steere					×						
Craniorrhinus leucocephalus (Vieill.)						×					
waldeni Sharpe		×									
MEROPIDÆ.											
Merops americanus P. L. S. Müll.	×	×	×	×	×	×			×	×	×
CAPRIMULGIDÆ.											
Lyncornis macrotis (Vigors)			×	×		×	×				
Caprimulgus griseatus Wald.		×	×	×		×			×	×	
mindanensis Mearns						×					
manillensis Wald.	×	×	×	×	×	×	×		×	×	
HEMIPROCNIIDÆ.											
Hemiprocne major (Hartert)		×	×	×					×	×	
MICROPODIDÆ.											
Collocalia whiteheadi Grant[b]	×		×	×	×				×	×	×
origenis Oberh.						×					
troglodytes Gray	×	×	×	×	×	×			×	×	
marginata Salvad.		×	×	×	×	×			×	×	×
isonota Oberh.			×	×		×		×			

[a] Described from Cagayan, Luzon; this is possibly the young of *P. manillæ*.

[b] Another subspecies is based on Palawan specimens. Several local subspecies have been described that I do not include in this table.

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
MICROPODIDÆ—Continued.											
Chætura dubia McG			×	×							
picina Tweedd					×	×					
Tachornis pallidior McG		×		×	×	×				×	
TROGONIDÆ.											
Pyrotrogon ardens (Temm.)				×	×	×	×				
CUCULIDÆ.											
Surniculus velutinus Sharpe		×	×	×	×	×	×	×			
Eudynamys frater McG											×
Centropus mindorensis (Steere)			×								
carpenteri Mearns											×
steeri B. and W			×								
viridis (Scop.)		×	×	×	×	×	×	×	×	×	×
melanops Less					×	×	×				
unirufus (Cab. and Heine)				×							
Dryococcyx harringtoni Sharpe *	×										
Dasylophus superciliosus (Cuv.)*				×							
Lepidogrammus cumingi (Fraser)*				×							
PICIDÆ.											
Yungipicus validirostris (Blyth)			×	×							
maculatus (Scop.)		×								×	
menagei B. and W									×		
leytensis Steere					×						
fulvifasciatus Hargitt						×	×				
ramsayi Hargitt								×			
siasiensis Mearns								×			
Tiga everetti Tweedd	×										
Chrysocolaptes erythrocephalus Sharpe	×										
hæmatribon (Wagler)				×							
lucidus (Scop.)						×	×				
montanus Grant						×					
rufopunctatus Hargitt					×						
xanthocephalus W. and L		×									
Lichtensteinipicus funebris (Val.)				×							
fuliginosus (Tweedd.)					×	×					
Thriponax confusus Stresemann[c]				×							
pectoralis Tweedd					×						
multilunatus McG						×	×				
suluensis Blas								×			
philippinensis Steere		×									
mindorensis Steere			×								
hargitti Sharpe	×										

[c] This is the distribution of the Philippine forms of *Thriponax* given by Stresemann, Nov. Zool. **20** (1913) 318–320.

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
EURYLÆMIDÆ.											
Sarcophanops steeri (Sharpe)*						×	×				
samarensis Steere					×						
PITTIDÆ.											
Pitta erythrogastra Temm	×	×	×	×	×	×	×	×	×	×	
propinqua (Sharpe)	×										
kochi Brüggemann				×							
atricapilla Less	×	×	×	×	×	×	×	×	×	×	
steeri Sharpe					×	×					
MUSCICAPIDÆ.											
Cyornis herioti Ramsay				×							
philippinensis Sharpe		×	×	×	×	×	×	×	×	×	
lemprieri Sharpe	×										
platenæ (Blas.)	×										
Muscicapula luzoniensis Grant			×	×							(d)
nigrorum Whitehead		×									
montigena Mearns						×					
basilanica (Sharpe)						×	×				
samarensis B. and W					×						
Gerygone simplex Cab			×	×							
rhizophoræ Mearns						×		×			
Camiguinia helenæ (Steere)*					×	×					×
Cyanomyias cœlestis (Tweedd.)*		×		×		×	×		×		
Rhipidura superciliaris (Sharpe)						×	×				
samarensis (Steere)					×						
albiventris (Sharpe)		×									
cyaniceps (Cassin)				×							
sauli B. and W									×		
nigrocinnamomea Hartert						×					
hutchinsoni Mearns						×					
nigritorquis Vigors	×	×	×	×	×	×	×	×	×	×	
Xeocephus rufus (Gray)		×	×	×	×				×	×	
cinnamomeus Sharpe						×	×	×			
cyanescens Sharpe	×										
Terpsiphone periopthalmica (Grant)				×							×
Rhinomyias albigularis B. and W		×									
goodfellowi Grant						×					
ruficauda (Sharpe)					×	×	×				
mindanensis Mearns						×					

[d] The *Muscicapula* from Calayan is nearly related to *M. luzoniensis*, but is a distinct, undescribed species.

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
MUSCICAPIDÆ—Continued.											
ocularis B. and W								×			
insignis Grant				×							
Cryptolopha olivacea (Moseley)		×		×	×	×		×			
cebuensis Dubois										×	
nigrorum Moseley		×	×	×							
mindanensis Hartert						×					
malindangensis Mearns						×					
xanthopygia Whitehead	×										
Eumyias panayensis Sharpe[e]		×									
nigrimentalis (Grant)			×	×							
nigriloris (Hartert)						×					
CAMPOPHAGIDÆ.											
Artamides difficilis (Hartert)	×										
guillemardi Salvad								×			
striatus (Bodd.)				×							
kochi Kutter					×	×	×				
panayensis Steere		×									
mindorensis Steere			×						×		
cebuensis Grant										×	
Malindangia mcgregori Mearns*						×					
Edolisoma cærulescens (Blyth)				×							
alterum Ramsay										×	
panayense Steere		×									
everetti Sharpe								×			
mindanense (Tweedd.)						×	×				
elusum McG			×	×							
Pericrocotus marchesæ Guillem								×			
novus McG		×		×							
leytensis Steere					×						
johnstoniæ Grant						×					
Lalage melanoleuca (Blyth)			×	×							
minor (Steere)					×	×					
PYCNONOTIDÆ.											
Chloropsis palawanensis (Sharpe)	×										
flavipennis (Tweedd.)						×				×	
Irena cyanogastra Vigors				×							
ellæ Steere					×						
melanochlamys Sharpe						×	×				
tweeddali Sharpe	×										

[e] Hartert records this species as occurring in Obi Major.

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
PYCNONOTIDÆ—Continued.											
Hypsipetes fugensis Grant											×
batanensis Mearns											×
camiguinensis McG											×
Iole striaticeps Sharpe	×										
everetti (Tweedd.)					×	×					
haynaldi (Blas.)								×			
rufigularis (Sharpe)						×	×				
gularis (Pucheran)				×	×	×				×	
guimarasensis Steere		×									
mindorensis Steere			×								
siquijorensis Steere		×									
cinereiceps B. and W									×		
monticola B. and W										×	
Poliolophus urostictus (Salvad.)*				×	×	×	×				
Trichophorus frater (Sharpe)	×										
palawanensis (Tweedd.)	×										
Pycnonotus goiavier (Scop.)		×	×	×	×	×	×	×	×	×	
cinereifrons (Tweedd.)	×										
TIMELIIDÆ.											
Pseudotharrhaleus caudatus Grant*				×							
unicolor Hartert						×					
griseipectus Mearns						×					
malindangensis Mearns						×					
Turdinus rufifrons (Tweedd.)	×										
Ptilocichla falcata Sharpe*	×										
basilanica Steere							×				
mindanensis Steere						×					
minuta B. and W					×						
Anuropsis cinereiceps (Tweedd.)	×										
Dasycrotapha speciosa Tweedd.*		×									
Zosterornis striatus Grant*				×							
whiteheadi Grant				×							
dennistouni Grant				×							
pygmæus Grant					×						
plateni (Blas.)						×					
capitalis (Tweedd.)					×	×	×				
nigrocapitatus (Steere)					×						
affinis McG				×							
Mixornis woodi Sharpe	×										
cagayanensis Guillem.[1]											

[1] *Mixornis cagayanensis* inhabits Cagayan Sulu only.

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
TIMELIIDÆ—Continued.											
Macronous striaticeps Sharpe							×				
mindanensis Steere					×	×					
montanus Mearns						×					
kettlewelli Guillem								×			
Leonardina woodi (Mearns)*						×					
Brachypteryx poliogyna Grant			×	×							
brunneiceps Grant		×									
mindanensis Mearns						×					
malindangensis Mearns						×					
TURDIDÆ.											
Planesticus mindorensis (Grant)			×								
thomassoni (Seebohm)				×							
mayonensis (Mearns)				×							
kelleri (Mearns)						×					
nigrorum (Grant)		×									
malindangensis (Mearns)						×					
Geokichla cinerea B. and W			×								
mindanensis Mearns						×					
Chaimarrornis bicolor Grant				×							
Copsychus mindanensis (Bodd.)		×	×	×	×	×	×	×	×	×	
Kittacincla luzoniensis (Kittl.)				×							
parvimaculata McG				×							
superciliaris B. and W		×									
cebuensis Steere										×	
nigra Sharpe	×										
SYLVIIDÆ.											
Tribura seebohmi (Grant)				×							
Orthotomus frontalis Sharpe					×	×					
mearnsi McG							×				
castaneiceps Walden		×									
derbianus Moore				×							
chloronotus Grant				×							
cinereiceps Sharpe						×	×				
nigriceps Tweedd						×					
samarensis Steere					×						
Megalurus tweeddalei McG		×	×	×	×	×	×		×	×	
Horornis seebohmi (Grant)				×							
Phyllergates philippinus Hartert				×							
heterolæmus Mearns						×					

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
LANIIDÆ.											
Cephalophoneus validirostris (Grant)			×	×							
suluensis Mearns								×			
Hyloterpe philippinensis Walden				×							
apoensis Mearns		×			×	×	×				
fallax McG											×
illex McG											×
albiventris Grant			×	×							
whiteheadi Sharpe	×										
winchelli B. and W		×							×	×	
homeyeri (Blasius)								×			
PARIDÆ.											
Pardaliparus elegans (Less.)			×	×	×					×	
albescens McG		×									
edithæ McG											×
mindanensis Mearns						×					
suluensis Mearns								×			
amabilis (Sharpe)	×										
Penthornis semilarvatus (Salvad.)*		×		×							
tessacourbe (Scop.)						×					
SITTIDÆ.											
Callisitta palawana (Hartert)	×										
œnochlamys (Sharpe)		×		×						×	
mesoleuca (Grant)				×							
lilacea (Whitehead)					×	×	×				
CERTHIIDÆ.											
Rhabdornis mystacalis (Temm.)*				×							
longirostris McG		×									
minor Grant					×	×	×				
inornatus Grant					×						
ZOSTEROPIDÆ.											
Zosterops meyeni Bp				×					×		×
whiteheadi Hartert				×							
vulcani Hartert						×					
halconensis Mearns			×								
batanis McG											×
siquijorensis B. and W		×									
boholensis McG					×						
everetti Tweedd										×	
basilanica Steere						×	×	×			

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
ZOSTEROPIDÆ—Continued.											
Zosterops meyleri McG.											×
richmondi McG.ε											
luzonica Grant				×							
aureiloris Grant			×	×							
nigrorum Tweedd		×							×		
goodfellowi Hartert						×					
malindangensis Mearns						×					
Hypocryptadius cinnamomeus Hartert*						×					
DICÆIDÆ.											
Dicæum retrocinctum Gould			×								
hæmatostictum Sharpe		×									
papuense (Gm.)		×		×	×	×	×			×	×
luzoniense Grant				×							
apo Hartert						×					
bonga Hartert					×						
dorsale Sharpe		×									
pallidius B. and W										×	
xanthopygium Tweedd			×	×							
intermedium B. and W									×		
sibuyanicum B. and W									×		
assimile B. and W								×			
sibutuense Sharpe								×			
cinereigulare Tweedd					×	×					
besti Steere		×									
flaviventer Meyer										×	
pygmæum (Kittlitz)	×	×	×	×	×				×		×
davao Mearns						×					
hypoleucum Sharpe							×	×			
mindanense Tweedd						×	×	×			
everetti Tweedd					×						
obscurum Grant				×							
nigrilore Hartert						×					
NECTARINIIDÆ.											
Prionochilus johannæ Sharpe	×										
quadricolor Tweedd										×	
olivaceus Tweedd					×	×	×				
bicolor B. and W						×					
inexpectatus Hartert		×	×	×	×						
anthonyi McG				×							

ε *Zosterops richmondi* is known only from Cagayancillo and so cannot be placed in any island group of this table.

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
NECTARINIIDÆ—Continued.											
Acmonorhynchus æruginosus (B. and W.)			×	×		×			×	×	
affinis Zimmer	×										
Æthopyga magnifica Sharpe		×							×	×	
boltoni Mearns						×					
shelleyi Sharpe	×										
bella Tweedd					×	×					
arolasi B. and W								×			
bonita B. and W		×								×	
flavipectus Grant			×	×							
rubrinota McG				×							
Eudrepanis pulcherrima Sharpe					×	×	×				
jefferyi Grant				×							
decorosa McG					×					×	
Leptocoma sperata (Linn.)	×	×	×	×	×	×			×		×
henkei (Meyer)				×							
juliæ (Tweedd.)						×	×	×			
Cyrtostomus flagrans (Oust.)				×							
guimarasensis (Steere)		×									
jugularis (Linn.)		×	×	×	×	×	×	×	×	×	
aurora Tweedd	×										
Anthreptes chlorigaster Sharpe		×		×		×	×		×	×	
wiglesworthi Hartert								×			
cagayanensis Mearns[h]											
griseigularis Tweedd			×	×	×	×					
Arachnothera flammifera Tweedd					×	×	×				
dilutior Sharpe	×										
philippinensis (Steere)					×	×					
ALAUDIDÆ.											
Mirafra philippinensis Ramsay			×	×		×					
FRINGILLIDÆ.											
Loxia luzoniensis Grant				×							
Pyrrhula leucogenys Grant				×							
steerei Mearns						×					
PLOCEIDÆ.											
Munia jagori Martens	×	×	×	×	×	×	×	×	×	×	×
cabanisi Sharpe		×	×	×							
Urolonchа everetti (Tweedd.)	×	×	×	×	×	×	×	×	×	×	×
Reichenowia brunneiventris Grant				×	×						

[h] Cagayan Sulu only.

TABLE 2.—*Showing the distribution of endemic species of Philippine land birds by groups of islands*—Continued.

Species.	(1) Palawan group.	(2) Central islands.	(3) Mindoro.	(4) Luzon group.	(5) Samar-Leyte.	(6) Mindanao.	(7) Basilan.	(8) Bongao-Sulu.	(9) Romblon group.	(10) Cebu.	(11) Babuyanes-Batanes.
EULABETIDÆ.											
Sarcops calvus (Linn.)*			×	×		×	×	×	×		
melanonotus Grant		×	×	×	×	×	×		×	×	
Eulabes palawanensis Sharpe	×										
Goodfellowia miranda Hartert*						×					
Lamprocorax panayensis (Scop.)	×	×	×	×	×	×	×	×	×	×	×
todayensis Mearns						×					
ORIOLIDÆ.											
Oriolus acrorhynchus Vigors	×	×	×	×	×	×	×	×	×	×	×
isabellæ Grant				×							
albiloris Grant				×							
samarensis Steere					×	×					
steeri Sharpe		×									
basilanicus Grant						×	×				
cinereogenys B. and W								×			
assimilis Tweedd										×	
DICRURIDÆ.											
Dicrurus balicassius (Linn.)			×	×							
striatus Tweedd					×	×	×				
w uluensis Hartert								×			
mirabilis (Wald. and Lay.)		×								×	
Dicruropsis palawanensis (Tweedd.)	×										
cuyensis (McG.)	×										
worcesteri (McG.)			×								
menagei (B. and W.)									×		
Bhuchanga palawanensis Whitehead	×										
CORVIDÆ.											
Corvus philippinus Bp	×	×	×	×	×	×	×	×	×	×	×
pusillus Tweedd	×		×								
samarensis Steere					×	×					

It is interesting to note that the endemic species *Munia jagori*, *Uroloncha everetti*, *Lamprocorax panayensis*, *Oriolus acrorhynchus*, and *Corvus philippinus* are found in all of the island groups, or subprovinces. *Centropus viridis* is unique in being the only

endemic species that reaches all groups except the Palawan group. The isolation of the Babuyanes and Batanes is evident when it is noted that *Cacatua hæmaturopygia, Tanygnathus lucionensis, Pitta erythrogastra, P. atricapilla,* and *Rhipidura nigritorquis* are found in none of those northern islands. Five common endemic species are found in all groups except Palawan and the Babuyanes-Batanes; these species are *Zonophaps poliocephala, Cyornis philippinensis, Pycnonotus goiavier, Copsychus mindanensis,* and *Cyrtostomus jugularis.*

Most of the endemic land birds are confined to single islands or groups of islands, and they can be used to indicate the relative distinctness of the various island groups. Counting the species that are confined to single groups of islands the following results are obtained:

	Species.
Palawan group	40
Central islands	32
Mindoro	17
Luzon group	61
Samar-Leyte	27
Mindanao	51
Basilan	7
Bongao-Sulu	30
Romblon group	9
Cebu	12
Babuyanes-Batanes	14

In general it may be stated that large islands of diversified topography, extensive highlands, and large areas of uncut lowland forest yield more species than do small low islands or islands from which most of the primary forest has been cut. In small islands, such as Cuyo, Cagayancillo, and Batan, there must be few if any unknown resident species, because it takes but a few days to visit all parts of any one of them. In Luzon, Mindoro, and Mindanao there are large areas of uncut forest, both lowland and highland, and no thorough zoölogical exploration has been carried on in any of these islands. Most of the work done so far has been the hurried gathering of specimens in limited areas for the purpose of discovering new species and adding data on distribution. None of this work has been either intensive or extensive.

Aside from the possible discovery of unknown species, ornithological work in any of the islands of the Archipelago will yield great quantities of information on the food, the nesting habits, the molts, and the migration of Philippine birds.

ILLUSTRATIONS

PLATE 1

Map of the Philippine Islands, showing the commercial forests (green) and the division of the Archipelago into zoögeographic subprovinces (red).

PLATE 2

FIG. 1. Bancoran Island, in Sulu Sea, as seen at low tide. The trees belong to a species of *Pisonia*. (Photograph by Cortes.)
2. Bancoran Island, Sulu Sea, at high tide. (Photograph by Cortes.)
3. Maeander Reef, Sulu Sea. (Photograph by Cortes.)

PLATE 3

FIG. 1. Hundreds of brown boobies, *Sula leucogastra* (Boddaert), on Usong Island, Tubbataha Reef, Sulu Sea. (Photograph by Worcester and Cortes.)
2. A colony of sooty terns, *Sterna fuscata* Linnæus, with young, on Maeander Reef, Sulu Sea. There are a few brown boobies in this colony. (Photograph by Worcester and Cortes.)

PLATE 4

Brown and white boobies on Usong Island, Tubbataha Reef, Sulu Sea. (Photograph by Worcester and Cortes.)

PLATE 5

FIG. 1. Monument marking the boundary between Rizal and Bulacan Provinces, Luzon, erected in 1858; kilometer 13, Manila-North Road. (Half-tone etching loaned by the Bureau of Public Works.)
2. Typical roadside vegetation in Bulacan Province, Luzon; kilometer 23, Manila-North Road. (Half-tone etching loaned by the Bureau of Public Works.)

PLATE 6

FIG. 1. A typical road in Tayabas Province, Luzon, on the Manila-South Road. In a coconut region. (Half-tone etching loaned by the Bureau of Public Works.)
2. Typical cultivated vegetation in Cavite Province, Luzon. (Half-tone etching loaned by the Bureau of Public Works.)

PLATE 7

FIG. 1. A flight of locusts near Pasay, Luzon. (Photograph by Cortes.)
2. A clump of bamboo near Pasay, partly defoliated by locusts. (Photograph by Cortes.)

PLATE 8

A clump of spiny bamboo, *Bambusa spinosa* Roxburgh. (Half-tone etching loaned by the Bureau of Forestry.)

PLATE 9

Interior of a grove of thin-walled bamboo, *Schizostachyum lumampao* (Blanco) Merrill. (Half-tone etching loaned by the Bureau of Forestry.)

PLATE 10

Cementerio del Norte, Manila; a driveway near the entrance. (Photograph by Martin.)

PLATE 11

Montalban Gorge, Rizal Province, Luzon; looking up stream toward the site of the dam. (Photograph by Martin.)

PLATE 12

A part of Bay Lake, Laguna Province, Luzon. The checkerboard effect is produced by the dikes of rice fields. The town in the middle distance is Paetè. The churches of two other towns can be seen farther away. (Photograph by Martin.)

PLATE 13

Rice fields in Bulacan Province, Luzon; kilometer 27, Manila-North Road. A typical view in a cultivated lowland region. (Half-tone etching loaned by the Bureau of Public Works.)

PLATE 14

A scene in Laguna Province, Luzon. Rice fields in the foreground and typical cultivated vegetation in the middle distance. (Half-tone etching loaned by the Bureau of Public Works.)

PLATE 15

Caiñgins in the mountains of northern Negros; showing typical clearing and cultivation; uncut primary forest on the steeper slopes. (Photograph by the Bureau of Forestry.)

PLATE 16

Camp of R. C. McGregor on Baco River, in northern Mindoro. This house accommodated three men. Trees had to be cut to make room enough to build this shack. The nipa roofing material was carried in from the coast in a banca. The other materials were obtained in the surrounding forest. (Photograph by McGregor.)

PLATE 17

Mount Halcon, Mindoro, as seen from camp on Baco River. The outline of the trees is characteristic of uncut primary lowland forest. The photograph was taken just after sunset. (Photograph by McGregor.)

PLATE 18

FIG. 1. *Pitta kochi* Brüggemann. (From a photograph of the plate in the Proceedings of the Zoölogical Society of London, 1878.)
2. *Dasycrotapha speciosa* Tweeddale. (From a photograph of the plate in the Proceedings of the Zoölogical Society of London, 1878.)
3. *Chloropsis palawanensis* (Sharpe), two upper figures; *Ptilocichla falcata* Sharpe, lower figure. (From a photograph of the plate in the Transactions of the Linnean Society of London, 1877.)
4. *Dicæum xanthopygium* Tweeddale and *Uroloncha everetti* (Tweeddale). (From a photograph of the plate in the Proceedings of the Zoölogical Society of London, 1877.)

PLATE 19

FIG. 1. *Chætura picina* Tweeddale. (From a photograph of the plate in the Proceedings of the Zoölogical Society of London, 1878.)
2. *Oriolus steeri* Sharpe. (From a photograph of the plate in the Catalogue of the Birds in the British Museum, 3.)
3. *Sarcophanops steeri* Sharpe. (From a photograph of the plate in the Transactions of the Linnean Society of London, 1877.)
4. *Irena tweeddali* Sharpe, upper figure; *Irena melanochlamys* Sharpe, lower figure. (From a photograph of the plate in the Transactions of the Linnean Society of London, 1877.)

PLATE 20

FIG. 1. *Zonophaps mindorensis* (Whitehead). (From a photograph of the plate in the Ibis, 1896.)
2. *Penelopides manillæ* (Boddaert). (From a specimen in the Bureau of Science.)
3. *Hydrocorax hydrocorax* (Linnæus). (From a specimen in the Bureau of Science.)
4. *Thriponax pectoralis* Tweeddale. (From a photograph of the plate in the Catalogue of the Birds in the British Museum, 18.)

PLATE 21

FIG. 1. *Tanygnathus everetti* Tweeddale. (From a photograph of the plate in the Catalogue of the Birds in the British Museum, 20.)
2. *Bolbopsittacus intermedius* Salvadori. (From a photograph of the plate in the Catalogue of the Birds in the British Museum, 20.)
3. *Syrnium whiteheadi* Sharpe. (From a photograph of the plate in the Ibis, 1888.)
4. *Pithecophaga jefferyi* Grant. (From a photograph of the plate in the Ibis, 1897.)

PLATE 22

FIG. 1. A typical caiñgin in Occidental Negros. The small houses afford good living quarters for the collector and obviate the necessity of carrying tents. (Photograph by the Bureau of Forestry.)
2. Forest near Agusan River, in northern Mindanao. (Photograph by the Bureau of Forestry.)

PLATE 23

FIG. 1. Camp of E. A. Mearns, at 1,800 meters' elevation, on Mount Apo, Mindanao.

2. A clearing on level ground in Mindoro; made by Mañgyans. (Photograph by Miller.)

PLATE 24

FIG. 1. Grassland near Port Banga, Mindanao, showing the effect of clearings and fires. Some molave forest remains, at the left in the picture. (Photograph by Whitford.)

2. Characteristic vegetation near Bagabag, Rizal Province, Luzon. This type of vegetation is very common in the lowlands. The primary forest has been destroyed and the land left uncultivated. (Photograph by McGregor and Cortes.)

PLATE 25

FIG. 1. *Sonneratia caseolaris* (Linnæus) on an open coast, Bongabon, Mindoro.

2. Air roots of *Sonneratia caseolaris* growing in salt water. The numerous air roots in the foreground are characteristic.

PLATE 26

Dipterocarp forest at the edge of a clearing at an altitude of 450 meters on Mount Maquiling, Luzon. The conspicuous palms in the foreground are *Livistona* sp. The large feathery leaves near the ground at the edge of the forest belong to rattans. (Photograph by Brown.)

PLATE 27

Large dipterocarps in northern Negros. Most of the small trees have been cut. (Photograph by Martin.)

PLATE 28

Pine forest in the Benguet region, Luzon. The open parklike arrangement is typical. (Photograph by Martin.)

PLATE 29

Rice terraces near Banaue, Ifugao, Mountain Province, Luzon. These terraces are often made on the sides of very steep hills. In many places the height of a stone retaining wall is greater than the width of the level land above it. (Photograph by Worcester.)

PLATE 30

Interior view of a mangrove swamp near Bongabon, Mindoro. The large tree is *Sonneratia caseolaris* (Linnæus); the trees with prop roots are *Rhizophora conjugata* de Candolle; the smaller trees without prop roots are mainly *Bruguiera parviflora* Wight and Arnott.

PLATE 31

A cultivated nipa swamp; *Nipa fruticans* Wurmb.

PLATE 32

Midmountain forest at an altitude of 740 meters on Mount Maquiling, Luzon. The conspicuous vines in the background belong to the genus *Freycinetia*. The large bole on the right of the picture is a tree of the genus *Ficus*, showing fruits growing on the trunk. (Photograph by Brown.)

PLATE 33

A ravine in the lower part of the mossy forest, Mount Maquiling, Luzon. Note the tree ferns and the open character of the vegetation. (Photograph by Brown.)

PLATE 34

A level area near the lower limits of the mossy forest, Mount Maquiling, Luzon. The vegetation is much denser than in the ravine shown in plate 33. (Photograph by Brown.)

PLATE 35

The summit of Mount Pulog, Mountain Province, Luzon. This peak differs from most of the other high Philippine mountains in having the summit covered with grass.

PLATE 1. THE PHILIPPINE ISLANDS.

Fig. 1. Bancoran Island, at low tide.

Fig. 2. Bancoran Island, at high tide.

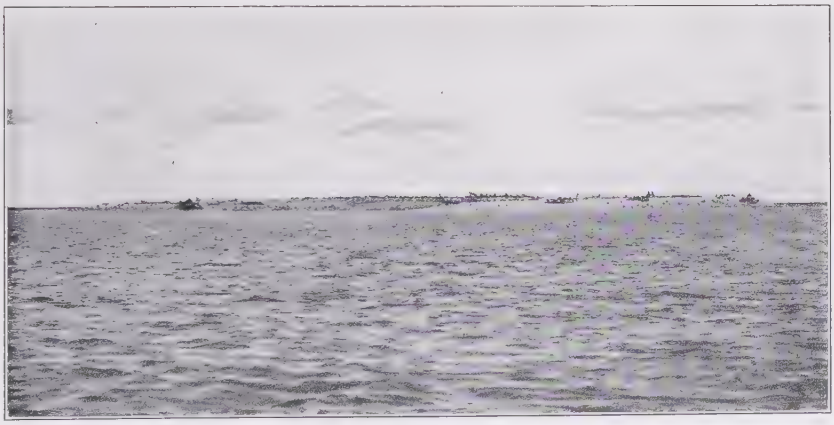

Fig. 3. Maeander Reef, Sulu Sea.

PLATE 2.

Fig. 1. Brown boobies on Usong Island.

Fig. 2. Sooty terns on Maeander Reef.

PLATE 3.

PLATE 4. BROWN AND WHITE BOOBIES ON USONG ISLAND.

Fig. 1. Bulacan-Rizal boundary monument.

Fig. 2. Vegetation in Bulacan Province.

PLATE 5.

Fig. 1. Vegetation in a coconut region.

Fig. 2. Vegetation in Cavite Province.

PLATE 6.

Fig. 1. A flight of locusts near Pasay.

Fig. 2. Bamboo defoliated by locusts.

PLATE 7.

PLATE 8. A CLUMP OF SPINY BAMBOO.

PLATE 9. INTERIOR OF MATURE FOREST OF THIN-WALLED BAMBOO.

PLATE 10. CEMENTERIO DEL NORTE, MANILA.

PLATE 11. MONTALBAN GORGE, RIZAL PROVINCE, LUZON.

PLATE 12. A PART OF BAY LAKE, LUZON.

PLATE 13. RICE FIELDS IN BULACAN PROVINCE, LUZON.

PLATE 14. A SCENE IN LAGUNA PROVINCE, LUZON.

PLATE 15. CAINGINS IN NORTHERN NEGROS.

PLATE 16. CAMP ON BACO RIVER, MINDORO.

PLATE 17. MOUNT HALCON, MINDORO, FROM CAMP ON BACO RIVER.

Fig. 1. Pitta kochi Brüggemann.

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PLATE 25.

PLATE 26. DIPTEROCARP FOREST AT THE EDGE OF A CLEARING.

PLATE 27. LARGE DIPTEROCARPS IN NORTHERN NEGROS.

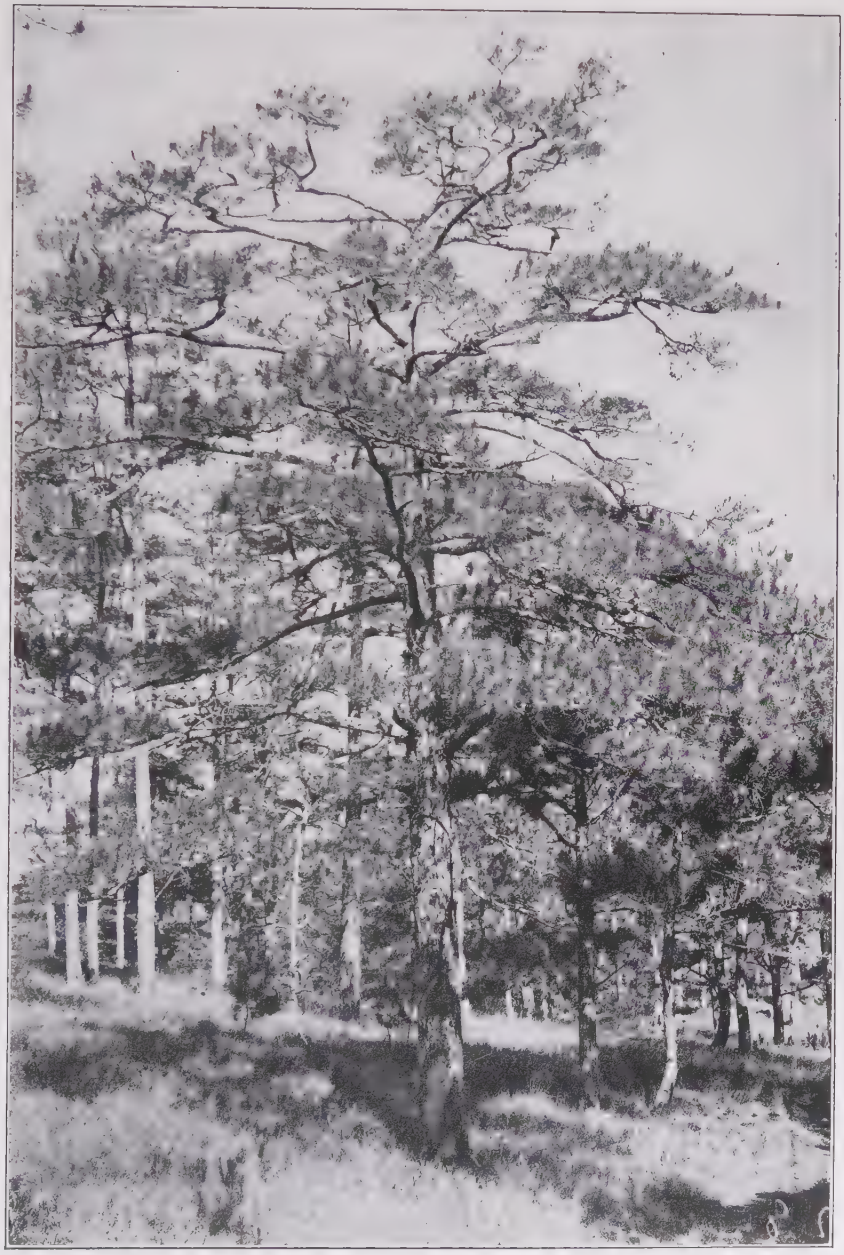

PLATE 28. PINE FOREST IN BENGUET, LUZON.

PLATE 29. RICE TERRACES IN IFUGAO SUBPROVINCE, LUZON.

PLATE 30. INTERIOR VIEW OF A MANGROVE SWAMP.

PLATE 31. A CULTIVATED NIPA SWAMP.

PLATE 32. MIDMOUNTAIN FOREST, AT 740 METERS, ON MOUNT MAQUILING.

PLATE 33. A RAVINE IN THE LOWER PART OF THE MOSSY FOREST, MOUNT MAQUILING.

PLATE 34. A LEVEL AREA, NEAR THE LOWER LIMITS OF THE MOSSY FOREST.

PLATE 35. THE SUMMIT OF MOUNT PULOG, LUZON.